Case studies in cross asset quant

Adaptation to low-yield environments

Quantitative Strategies
Global Markets Research

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Adapting to the investment challenges in a low-yield world

1. Extracting returns from G10 FX in a low carry environment
   FX carry has declined along with rate differentials – what can be done to generate returns from FX?

2. The search for defensive assets in a low-yield world
   Bonds have been a good defensive asset to protect against downturns – but at low yields, will they continue to help?

3. Earning returns from equities in a deleveraging environment
   Equity risk premium declines in a deleveraging environment – is there a replacement for long-only equities?

4. Making commodities work in turbulent times
   Long-only commodities have not performed – how can we make commodities work?
Extracting returns from G10 FX in a low-carry world
G10 FX carry is looking less attractive than before

FX carry trades were popular in Japan, but carry has underperformed with compression of rate differentials

The risk-adjusted performance of the carry trade has fallen sharply as G10 interest rate differentials have narrowed

2000-08
Average carry in G10: 4.6% p.a.
Sharpe ratio of G10 FX carry: 0.96

2009-15
Average carry in G10: 2.7% p.a.
Sharpe ratio of G10 FX carry: 0.35

Source: Bloomberg, Nomura Research. Carry of the G10 carry trade: average interest rate of the top 3 high yielding currencies in G10 minus average interest rate of the bottom 3 low yielding currencies. Sharpe ratios have been calculated using monthly data. Sample period: May 2000 to March 2015. The G10 FX carry strategy has a target volatility of 8% p.a.
But G10 Momentum looks bad too

G10 Momentum has not performed since 2004

Source: Nomura Research. Strategies scaled to 3% annual volatility. EM FX momentum on 10 liquid crosses. All strategies net of transaction costs.
Rotating between Carry and other investment styles

Other styles like momentum and value can provide positive returns even when carry is underperforming

Performance of Momentum + Value when Carry returns are in the bottom x%

- Momentum: Trend-following in G10 FX
- Value: Reversion to fair-value (based on PPP)

Regime of FX carry returns

What seems to work...

A diversified, dynamic styles portfolio has outperformed FX carry

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<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td>Styles portfolio</td>
<td>FX carry</td>
<td>Styles portfolio</td>
<td>FX carry</td>
</tr>
<tr>
<td>Returns (% p.a.)</td>
<td>7.8</td>
<td>6.1</td>
<td>5.1</td>
<td>3.0</td>
</tr>
<tr>
<td>Volatility (% p.a.)</td>
<td>6.6</td>
<td>8.7</td>
<td>5.8</td>
<td>8.6</td>
</tr>
<tr>
<td>Sharpe ratio</td>
<td>1.18</td>
<td>0.71</td>
<td>0.88</td>
<td>0.35</td>
</tr>
<tr>
<td>Max drawdown</td>
<td>9.3</td>
<td>25.0</td>
<td>7.4</td>
<td>17.1</td>
</tr>
<tr>
<td>Calmar ratio</td>
<td>0.84</td>
<td>0.25</td>
<td>0.69</td>
<td>0.18</td>
</tr>
</tbody>
</table>

Source: Bloomberg, Nomura Research (March 2015). All statistics have been calculated on monthly data. The individual styles (carry, momentum and value) have a target volatility of 8% p.a.
The search for defensive assets in a low-yield world
Bonds have been the only defense

Most traditional “alternatives” offer the same pro-cyclical risk as equities; bonds have been different

1: Bear market overlap is defined as the probability that the asset class is in a bear market if equities are in a bear market. A bear market is defined as a drawdown of greater than 1 standard deviation.

Source: Bloomberg, Nomura Research (Feb 2014). All statistics are calculated on monthly data. All returns are excess returns i.e. returns over cash rate. DM Equities: MSCI Daily TR Gross World USD (GDDUWI Index). Commodities: S&P GSCI excess return index (SPGSCIP Index). US credit: North America IG 5Y Unfunded return index (NMCINAIG before March 2007, ERIXCDIG Index after that). Hedge funds: HFRX Global Hedge Fund Index (HFRXGL Index). Listed private equity: LPX50 Listed Private Equity Index USD TR (LPX50TU Index). Global real estate: S&P Global REIT USD TR (SREITTGL Index). Cash rate: Fed funds effective rate (FEDL01 Index). 10yr UST returns have been calculated as the returns of holding and rolling the TY1 futures contract.
Can bonds play defense in the future?

No: low yield levels can significantly hamper the defensive nature of government bonds

Even in a crisis, bonds cannot rally much

Change in 10yr yields post Lehman shock (Sept 08 to Dec 08)

<table>
<thead>
<tr>
<th>Basis Points</th>
<th>USTs</th>
<th>Gilts</th>
<th>Bunds</th>
<th>JGBs</th>
</tr>
</thead>
<tbody>
<tr>
<td>-237</td>
<td>-199</td>
<td>-138</td>
<td>-51</td>
<td></td>
</tr>
</tbody>
</table>

Bonds and equities can move together

S&P 500 excess returns (lhs)

Source: Bloomberg, Nomura Research. All returns in this slide are excess returns i.e. returns over risk-free rate. All statistics have been calculated on monthly data. Bond returns have been calculated as the returns of holding and rolling the corresponding 10yr futures contract (TY and JB). DM Equities: MSCI Daily TR Gross World USD (GDDWII Index).
JGBs have become short put carry trades

Unlike most traditional assets and “alternatives”, momentum has a positive skew
Trend following can help provide downside protection

Momentum is expected to outperform during extreme returns

This results of a straddle-like behavior in practice


Source: Bloomberg, Nomura Research. Excess returns refer to return over cash. Cash rate: fed funds rate. MSCI world equities: GDDUWI Index. Index of CTAs: Barclay CTA Index (BARCCTA) Index. Excess returns of the CTA index have been scaled to have the same volatility as equities over this sample period, for ease of comparison. (May 2013).
Momentum is well-established across markets and assets

Momentum is consistent with financial theory after the 1970s and has strong empirical support

A long history of academic research into Momentum

1960s and early 70s
Efficient Markets equals Random Walk
Fama (1964), Samuelson (1965), Burton Malkiel (1973)

1970s and 80s
Markets are efficient but not random, existence of autocorrelation

1990s
Evidence of momentum in US stocks, alternative explanations

2000s
Momentum is universal and straddle-like, better understanding of drivers
Fung and Hsieh (2001), Griffin and Martin (2005), Gorton et al. (2008), Asness et al. (2009), Moskowitz, Ooi and Pedersen (2011)

Evidence from across markets and asset classes

<table>
<thead>
<tr>
<th></th>
<th>Equities TS Momentum</th>
<th>Rates TS Momentum</th>
<th>Commodities TS Momentum</th>
<th>EM FX TS Momentum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average returns</td>
<td>1.9%</td>
<td>9.1%</td>
<td>7.8%</td>
<td>12.6%</td>
</tr>
<tr>
<td>Volatility</td>
<td>4.7%</td>
<td>7.5%</td>
<td>9.3%</td>
<td>8.7%</td>
</tr>
<tr>
<td>Sharpe ratio</td>
<td>0.40</td>
<td>1.21</td>
<td>0.84</td>
<td>1.44</td>
</tr>
<tr>
<td>Max drawdown</td>
<td>-14.7%</td>
<td>-12.5%</td>
<td>-17.8%</td>
<td>-15.8%</td>
</tr>
<tr>
<td>% Positive months</td>
<td>55%</td>
<td>62%</td>
<td>54%</td>
<td>67%</td>
</tr>
</tbody>
</table>

Source: Bloomberg, Nomura. All statistics are based on daily data until end of Feb 2015. 1. Sample period for different momentum strategies: Equities – 07/2004 to 02/2015; Rates – 02/1990 to 02/2015; Commodities – 01/1970 to 02/2015; FX: 02/1996 to 02/2015. FX momentum results are only for EM FX momentum.
The strategic value of TS momentum in asset portfolios

TS Momentum does well during sell-offs, especially during extended bear markets

Negative correlation with equities during bear markets

Performance during specific crises

Source: Bloomberg, Nomura Research. All returns shown are excess returns i.e. returns over cash rate. Cash rate: fed funds rate. MSCI world equities: GDDUWI Index. Index of CTAs: Barclay CTA Index (BARCCTA) Index. The cross-asset momentum returns are already excess returns since it is an unfunded index.
Why most investors need this

Typical hedge-fund or real-money portfolios are negatively exposed to the time-series momentum factor.

Source: Nomura Research. Results of regressing a typical pension fund portfolio against cross-asset timeseries factors.
Earning returns from equities in a deleveraging environment
Volatility risk premia went mainstream in Japan

Japanese investors became big buyers of auto-callable knock-outs

Big market in equity index-linked Uridashi (~USD15 bn p.a.)

Buying what works—VRP outperforms equities

While the Uridashi structure can’t be fully replicated with simple options, it is most akin to the:

- investor selling the bank a down & in put
- owning a series of digital options with an upside knock-out

Source: Bloomberg, Nomura Research. Neil Sheppard and Vincent Li presentation ‘The Japan Uridashi Market, Jan 2013’. Nikkei returns are the returns of holding and rolling the first equity futures contract. VRP: returns on a selling a 1m variance swap with 0.25 vega notional
The picture in Europe is similar

Volatility risk premium vs long-only equities in Europe

Source: Bloomberg, Nomura research. Eurostoxxi returns are the returns of holding and rolling the first equity futures contract. VRP: returns on a selling a 1m variance swap with 0.25 vega notional
VRP can perform even when equities do not


VRP is similar to equities, not an “alternative”
Equity crashes are also bad periods for VRP

However VRP can add significant value in markets which are range-bound or slowly trending down

Source: Bloomberg, Nomura research. All returns have been scaled to 6% volatility. 6% is also close to the realized volatility of the VRP on S&P 500 in this sample. Equities: returns of holding and rolling the first equity futures contract. VRP: returns on a selling a 1m variance swap with 0.25 vega notional.
Low implied volatility is usually good for VRP

VRP returns depend on the difference between implied and realized volatility

No relationship between implied volatility level and returns

Performance is stronger when implied volatility is lower

Strong relationship between returns and implied - realised

Source: Nomura Research. For charts on the left, analysis based on data daily data from 1994-2014. For the chart on the right, we look at daily data between 2001 and 2014 and divide the sample period into three equally sized buckets based on the level of VIX. We then report the returns of the S&P 500 VRP strategy in each of these buckets. The full sample volatility of the VRP strategy is 6%.
Live performance of Nomura Volatility Risk Premium

Implementation can mitigate risks

- Strikes
- Vega profile
- Liquidity

2011-14 VRP Combined Vol Scaled S&P500 ER Vol Scaled HFRX Global Hedge Fund Index

<table>
<thead>
<tr>
<th></th>
<th>VRP Combined</th>
<th>Vol Scaled S&amp;P500 ER</th>
<th>Vol Scaled HFRX Global Hedge Fund Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annualised Return</td>
<td>33.46%</td>
<td>21.07%</td>
<td>12.73%</td>
</tr>
<tr>
<td>Volatility</td>
<td>13.94%</td>
<td>13.92%</td>
<td>13.91%</td>
</tr>
<tr>
<td>Sharpe ratio</td>
<td>2.40</td>
<td>1.51</td>
<td>0.92</td>
</tr>
</tbody>
</table>

Source: Nomura, Bloomberg. Data from 21/10/2011 to 31/12/2014. Past performance is no indication of future performance. This chart is based on the Swap format of the product. The Nomura Volatility Risk Premium combined portfolio ("VRP Combined") is an example portfolio for illustrative purposes only. On each expiry day of the Nomura Volatility Odd (resp. Even) month Risk Premium USD ER Index, the notional exposure to the Nomura Volatility Odd (resp. Even) month Risk Premium USD ER Index for the period until the next odd (resp. even) monthly expiry is determined by the combined portfolio level as of the immediately preceding business day. S&P500 Vol Scaled ER means a volatility-scaled version of S&P 500 Excess Return. Vol Scaled HFRX Global HF Index is a volatility-scaled version of HFRX Global Hedge Fund Index.
Making commodities work
Long-only commodities have not worked

Where is the risk premia in long-only commodities?

Long-only commodity returns are negative ignoring the one-time gain at the end of the Bretton Woods peg.

The underperformance is even more severe recently given concerns on slowdown in demand and declining inflation.

Commodities are also macro—like equities, rates or FX

Commodities are quite similar to other asset classes, contrary to common thinking

Commodities are also pro-cyclical, like equities

Carry matters for commodities, just like in FX

Commodities also have dynamic curves, just like interest rates

Principal component analysis shows that dynamic patterns are similar

<table>
<thead>
<tr>
<th>Component</th>
<th>% of the total variance explained</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crude oil curve over 5 years</td>
</tr>
<tr>
<td>Parallel shift/level</td>
<td>93.3%</td>
</tr>
<tr>
<td>Twist/Slope</td>
<td>5.2%</td>
</tr>
<tr>
<td>Bend/Convexity</td>
<td>0.8%</td>
</tr>
</tbody>
</table>

Source: Bloomberg, World Bank, Nomura Research. Top left chart shows excess returns of S&P GSCI. Shaded areas are when real world GDP growth was in the bottom quartile. S&P GSCI returns up to December 2014. World real GDP growth to December 2013. In the top right chart, carry refers to the difference between the index total returns and the index spot returns. For PCA analysis, calculations are based on data from 1997 to 2009.
Treating commodities like FX works

Macro Commodity Strategy (MaCS) has delivered positive returns despite turbulent times

<table>
<thead>
<tr>
<th>Live period performance of MaCS (Nov 09 – Dec 14)</th>
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</thead>
<tbody>
<tr>
<td>MaCS</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Returns (% p.a.)</td>
</tr>
<tr>
<td>Volatility (% p.a)</td>
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<tr>
<td>Calmar ratio</td>
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</table>

Source: Bloomberg, Nomura Research. MaCS: NMX3MC7U Index, Commodity hedge funds: HFRXCOM Index, S&P GSCI: SPGSCIP Index BCOM: BCOM Index. All returns are excess returns ie, returns over cash rate. For hedge funds, cash rate has been assumed to be the 1-month USD Libor. All statistics have been calculated on monthly data. In the chart all indices have been scaled to the same volatility as BCOM for ease of comparison.
Learning from Japan

Out of equities, into carry. Out of bonds, into trend following.

Old

New

- Commodities (long/short)
- FX Carry
- VRP
- Credit
- Bonds
- Trend following
Appendix A-1

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future distribution of returns.

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