Cross Asset Signals

UBS Quantitative Conference 2018

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Introduction

- There are three basic “signals” used for systematic cross asset investing: momentum, value and carry.
- In this presentation we will investigate some other signals.
- In particular
  – Skewness – buying assets with the lowest skew and shorting those with a higher skew seems effective
  – Economic momentum – buying currencies where the economy is strong appears to be a profitable strategy over time.

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Section 1

Portfolio construction and data

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Portfolio construction

- For most of the analysis in this presentation we will use a cross sectional approach within each asset class, thus creating (to a first approximation) portfolios which are neutral to the asset class.
- There is one exception to this approach which we will highlight as we go through.

Cross sectional portfolio construction

Example: 9 assets within an asset class, 6 with a positive score, 3 with a negative score

Ranked Score
>0
>0
>0
>0
>0
>0
<0
<0
<0

Rank assets by score

Subtract the average rank

Rescale so that $\sum_i |w_i| = 1$

XS weights
+4/20
+3/20
+2/20
+1/20
0
-1/20
-2/20
-3/20
-4/20

$$\boldsymbol{NET = 0}$$

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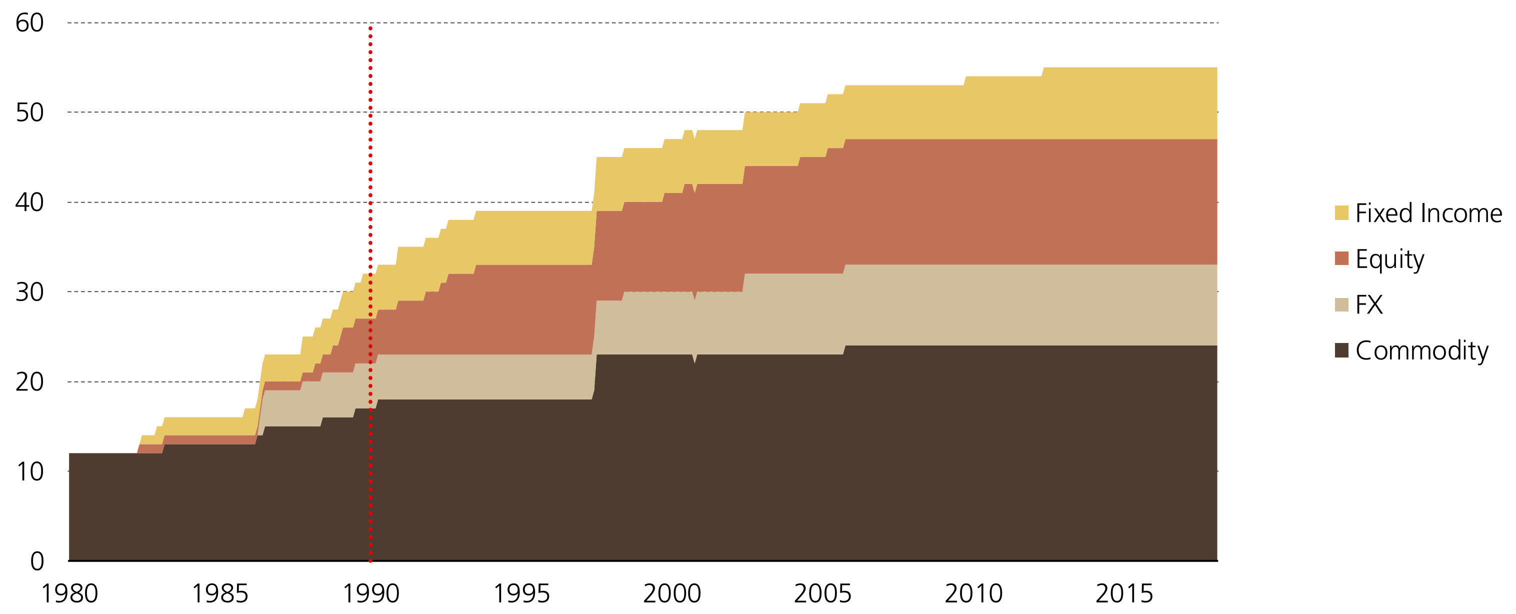
Source: UBS Quantitative Research

Dataset for back-testing

- Futures Data
  - Source: **Bloomberg**
  - Daily closing futures prices for 55 assets over the period January 1990 – Feb 2018:
    - 24 Commodities [17 in January 1990]
    - 8 Government Ten-Year Bonds [5 in January 1990]
    - 9 FX Rates (G10 pairs vs. USD) [5 in January 1990]
    - 14 Country Equity Indices [5 in January 1990]
    - ➢ See the appendix for the full list.

Number of assets per asset class



Source: Bloomberg, UBS

Section 2

Moments

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Moments

- We have published about low risk / low volatility investing within a cross asset universe in the past. Have the results held up over the past few years?
- In a recent Academic Research Monitor we looked at skewness – high (positive) skewed futures tend to underperform. We show some extended results on this topic.
- What about kurtosis?
- Ebner points out that one should care about co-skewness and co-kurtosis: I care how an asset changes my existing portfolio's skewness, not whether the asset has skewness by itself. So can we use these co-moments to create a portfolio?

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Section 2.A

Moments

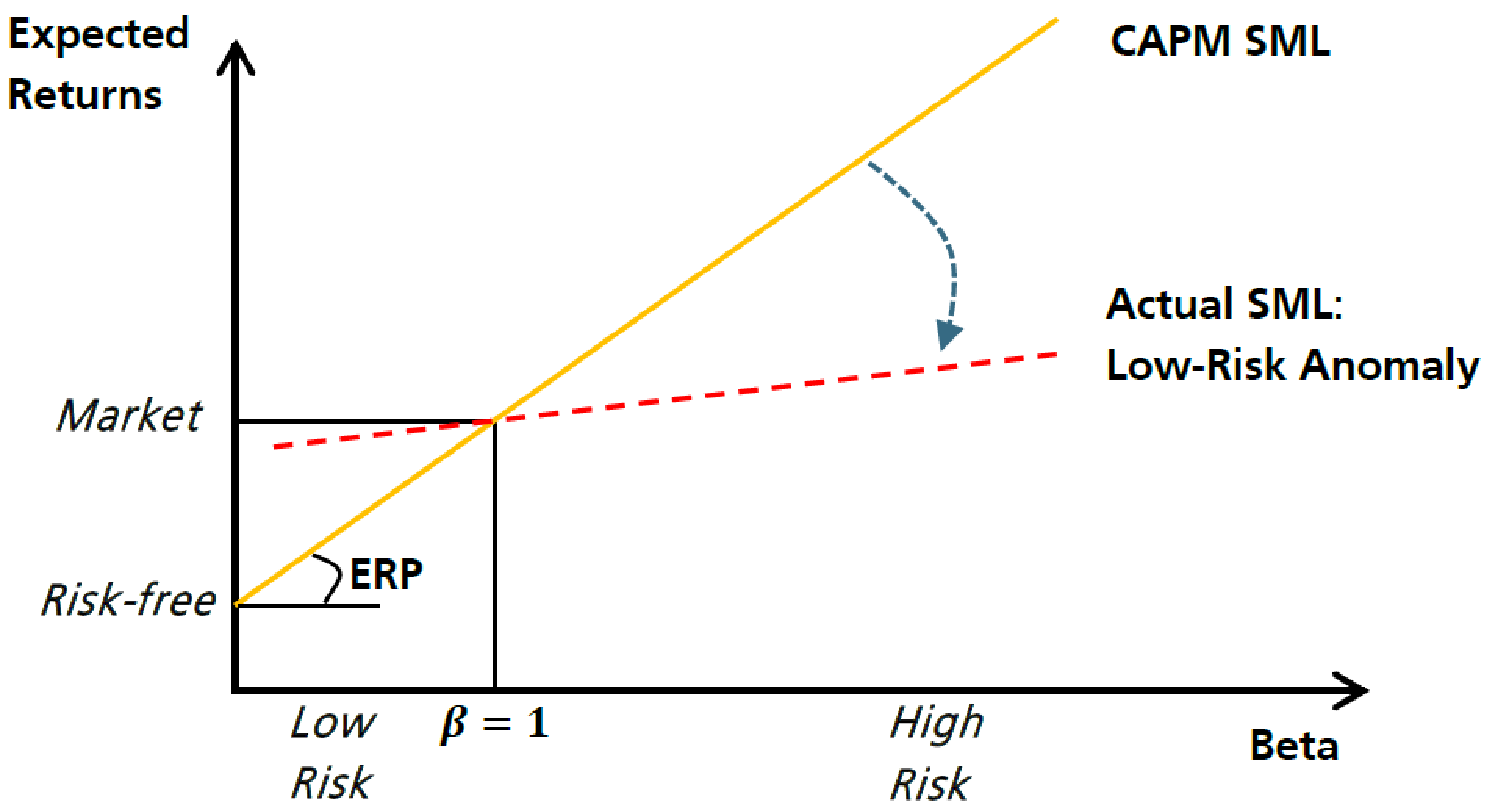
Volatility

Low risk investing

- A compelling empirical irregularity:
  - *Low-risk stocks outperform high-risk stocks*
  - Suggested explanations: benchmarked investing, leverage aversion, a preference for lottery-like stocks and time-variation of asset betas.
- What about other asset classes?
  - Equity indices
  - Commodities
  - Government bonds
  - FX rates
- Findings:
  - Strong low-risk patterns within equity indices
  - No information in first half in fixed income; high risk outperforms from 2008 onwards
  - No patterns in FX or commodities

Low-risk Investing: setting the scene

- The Security Market Line (SML) is empirically flatter than what CAPM predicts (Black, Jensen and Scholes, 1972).
- Higher risk stocks exhibit lower risk-adjusted returns than lower risk stocks.



Source: UBS Quantitative Research

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Portfolio Construction Methodology

Construct a three (two for fixed income) long only per asset class:

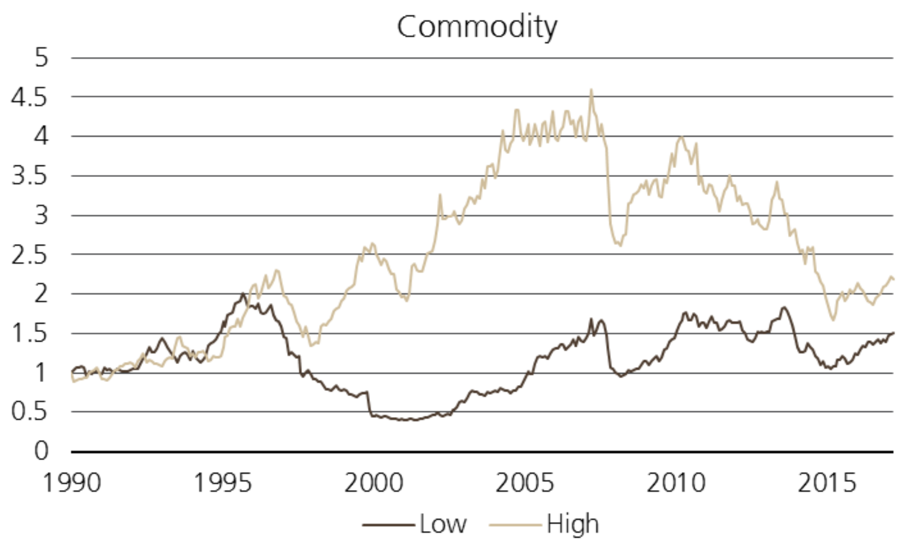
a) Rank assets per asset class based on the volatility of each asset (calculated using 12 months of daily data) from low to high.

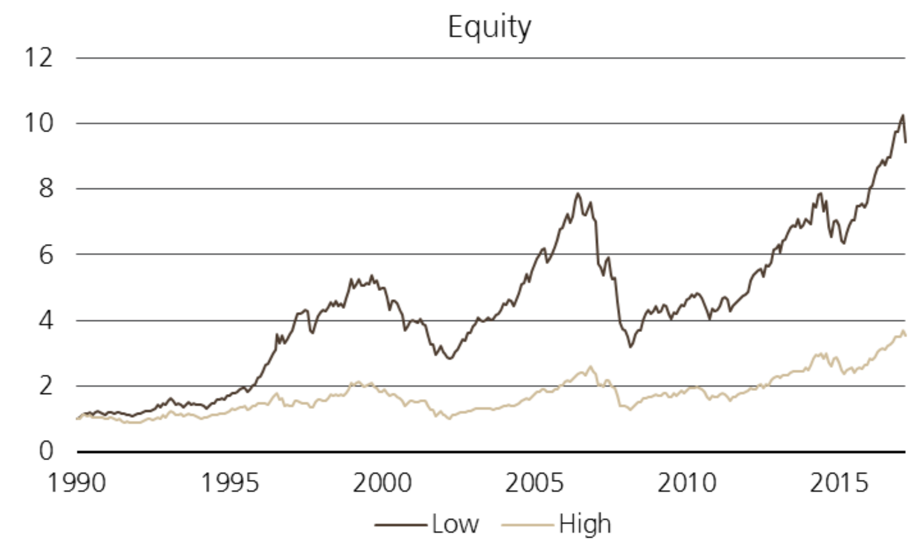
b) Construct equal weighted portfolios, rebalanced monthly

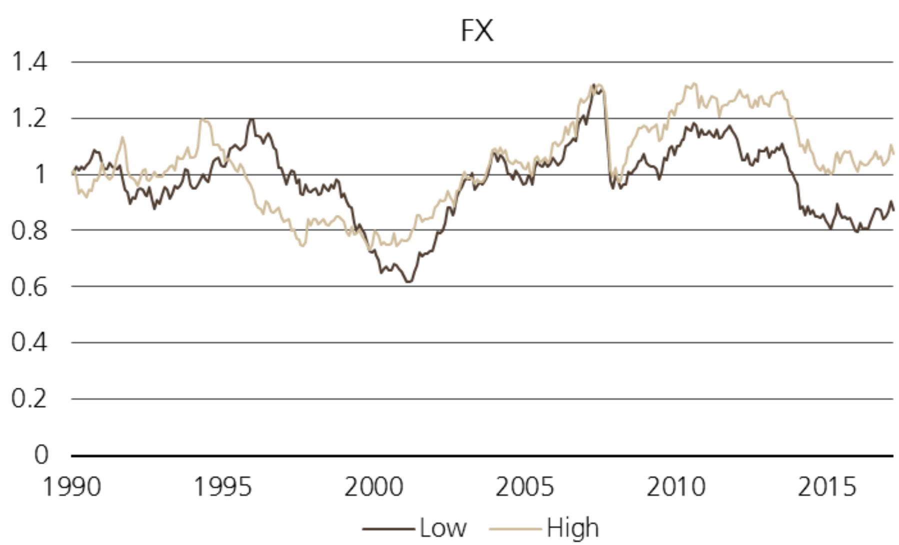
- Why not long-short? There is a problem with low risk investing – if you create a long – short portfolio then you have created a systematic bias towards a negative beta. Or even just a misalignment of volatilities between the long and short baskets.

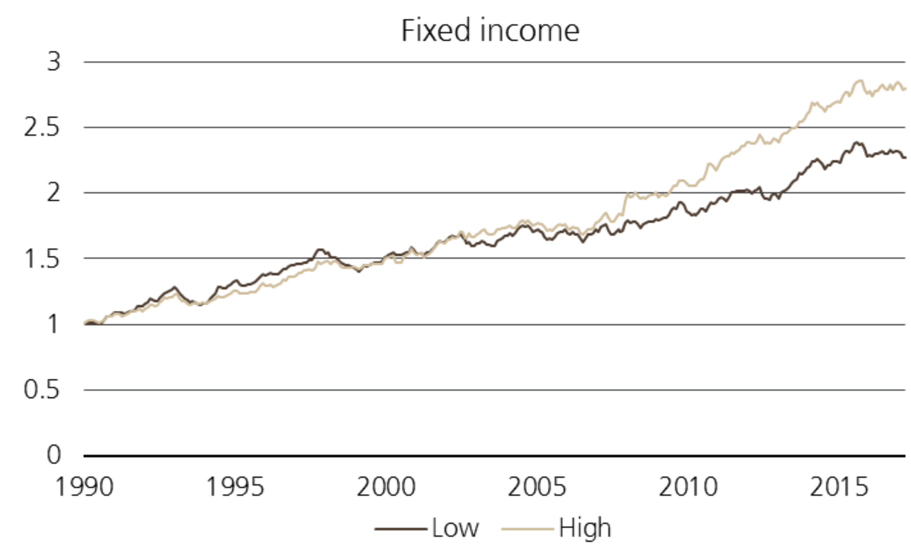
- Hence here we analyse just the long only performance.

Cross asset volatility based portfolio









Source: UBS Quantitative Research. Portfolios are volatility targeted to the average overall volatility of the underlying time series. For illustrative purposes only

Low risk and high risk: the results

	Commodity		Equity Indices		FX		Govt. Bonds	
	Low	High	Low	High	Low	High	Low	High
Annualized Return	2.2%	5.5%	7.4%	6.6%	0.3%	1.1%	2.2%	5.1%
Annualized Std Dev	11.3%	21.4%	12.9%	18.5%	6.8%	11.3%	2.9%	5.3%
Annualized Sharpe	0.19	0.26	0.57	0.36	0.05	0.10	0.78	0.97
Sortino ratio	0.08	0.11	0.24	0.15	0.02	0.04	0.37	0.50
Skewness	-0.97	0.03	-0.68	-0.47	-0.38	0.00	-0.14	0.04
Kurtosis	3.73	0.97	1.10	1.42	2.15	1.63	0.25	0.33
Alpha	0.33%	1.37%	1.88%	-1.37%	-0.20%	0.28%	-0.17%	0.15%
Beta	0.62	1.36	0.81	1.16	0.71	1.34	0.67	1.34

Source: UBS Quantitative Research. The figure reports various performance statistics using monthly excess returns for long only portfolios within equity indices, commodities, government bonds and FX rates. The alphas are estimated against an equally weighted portfolio (the "market") of all the assets of each asset class separately. For illustrative purposes only.

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Can we explain our results?

- There are a number of potential explanations of why low-risk patterns exist. We broadly expect these patterns to be experienced in markets that contain assets that are typically used in benchmarked strategies or are typically characterised by stringent leverage constraints.
  - Equity markets:
    - The majority of investors that engage in equity investing face leverage constraints and are evaluated against a broad market index
    - Pension funds, insurance funds, mutual funds, individual investors.
  - Government bond markets:
    - Similar to equities, the majority of investors that trade bonds are also expected to face leverage constraints and to be benchmarked.
    - Pension funds, insurance funds, mutual funds.
    - Absolute returns funds that trade bonds (e.g. global macro funds, stat-arb funds) face weaker constraints, but manage significantly less money.
    - This asset class did not behave quite as we expected.
  - Currencies and commodities:
    - Typically traded via forward or futures contracts, which are leverage-friendly instruments.
    - Typically traded either by absolute return funds (CTAs, global macro funds) or hedgers (for whom their reason to trade is completely different).
    - We would argue that both these asset classes would be unlikely to exhibit low-risk patterns.

Section 2.B

Moments

Skewness

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Skewness

- In “The Skewness of Commodity Futures Returns“ by Fernandez-Perez et al (2018) they show that commodity futures with the strongest negative skewness tend to outperform those with the most positive skewness very convincingly, and that this alpha remains significant after taking into account the standard commodity pricing models. They find that the long short skewness factor has a larger premium than any of the risk factors thus far considered in the literature.
- Their definition of skewness is the usual definition. They use daily returns over the previous 12 months and compute Pearson's moment coefficient of skewness:

$$skewness_i = \frac{1}{T}\sum\nolimits_t (r_{i,t} - \mu_i)^3/\sigma_i^3$$

where T is the number of daily returns over the previous year, μ_i is the average daily return to the asset i and σ_i^2 is the variance of the daily returns to the asset i.

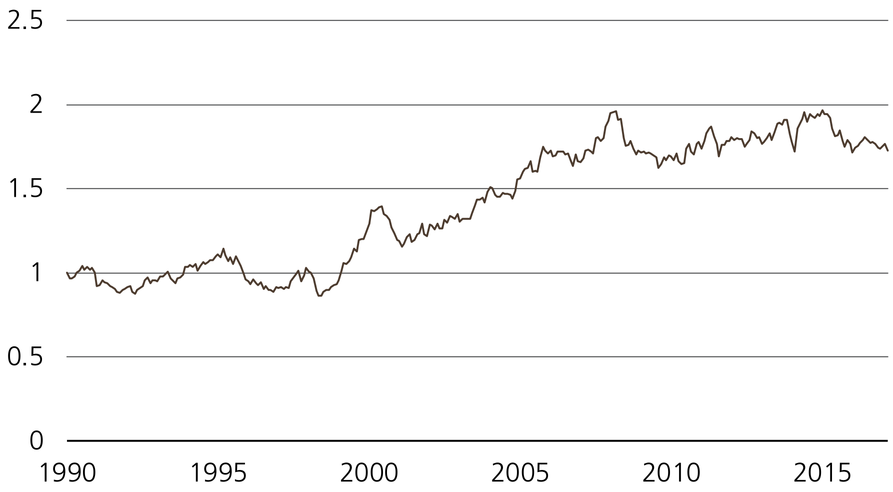
- Does this result hold for other asset classes?

Why should past skewness have an effect?

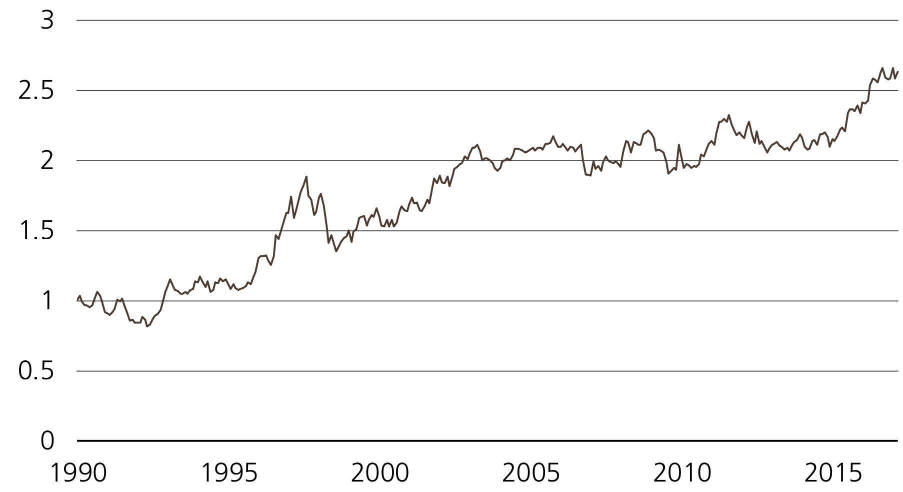
- Barberis and Huang (2008) show “in an economy with cumulative prospect theory investors, [a] skewed security can become overpriced relative to the prediction of the expected utility model, and can earn a negative average excess return. To be clear, it would not be surprising to learn that, in equilibrium, investors who overweight the tails of a portfolio return distribution value a positively skewed **portfolio** highly; what is surprising is that, in equilibrium, these investors value a positively skewed **security** highly, even if this security is in small supply.” [their highlighting]
- Harvey and Siddique (2000) say “Everything else being equal, investors should prefer portfolios that are right-skewed to portfolios that are left-skewed. This is consistent with the Arrow–Pratt notion of risk aversion. Hence, assets that decrease a portfolio’s skewness: i.e., that make the portfolio returns more left skewed, are less desirable and should command higher expected returns. Similarly, assets that increase a portfolio’s skewness should have lower expected returns”

Cross asset skewness by asset class

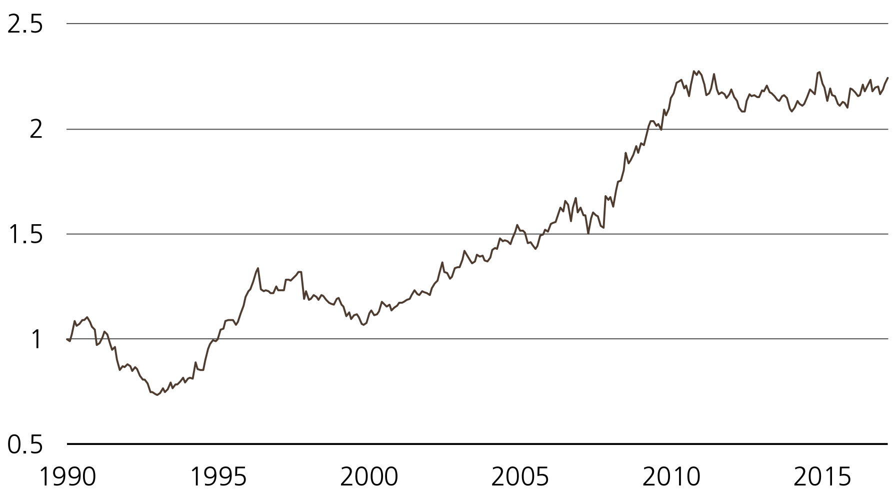
Commodity



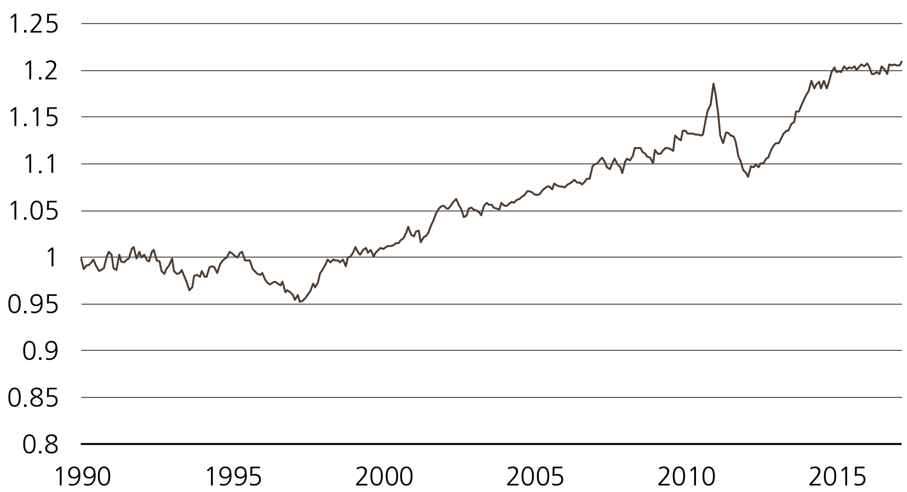
Equity



FX



Fixed income



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Source: UBS Quantitative Research

For illustrative purposes only

Cross asset skewness by asset class

Sample: 1991M01 – 2018M02	Commodities	Equity Indices	FX	Govt. Bonds
Average Geometric Return (%)	2.0%	1.9%	1.6%	0.7%
Average Arithmetic Return (%)	2.4%	2.1%	1.6%	0.7%
Annualised Volatility (%)	8.3%	5.1%	4.0%	1.9%
Skewness	-0.05	-0.05	-0.03	-0.23
Kurtosis	0.46	0.81	2.53	1.45
Maximum Drawdown (%)	-23%	-14%	-17%	-8%
Sharpe Ratio (annualised)	0.28	0.40	0.41	0.38
Sortino Ratio (annualised)	0.12	0.18	0.19	0.16
Correlation Matrix				
Commodities	1			
Equity Indices	0.10	1		
FX	0.04	0.01	1	
Govt. Bonds	-0.01	-0.09	0.05	1

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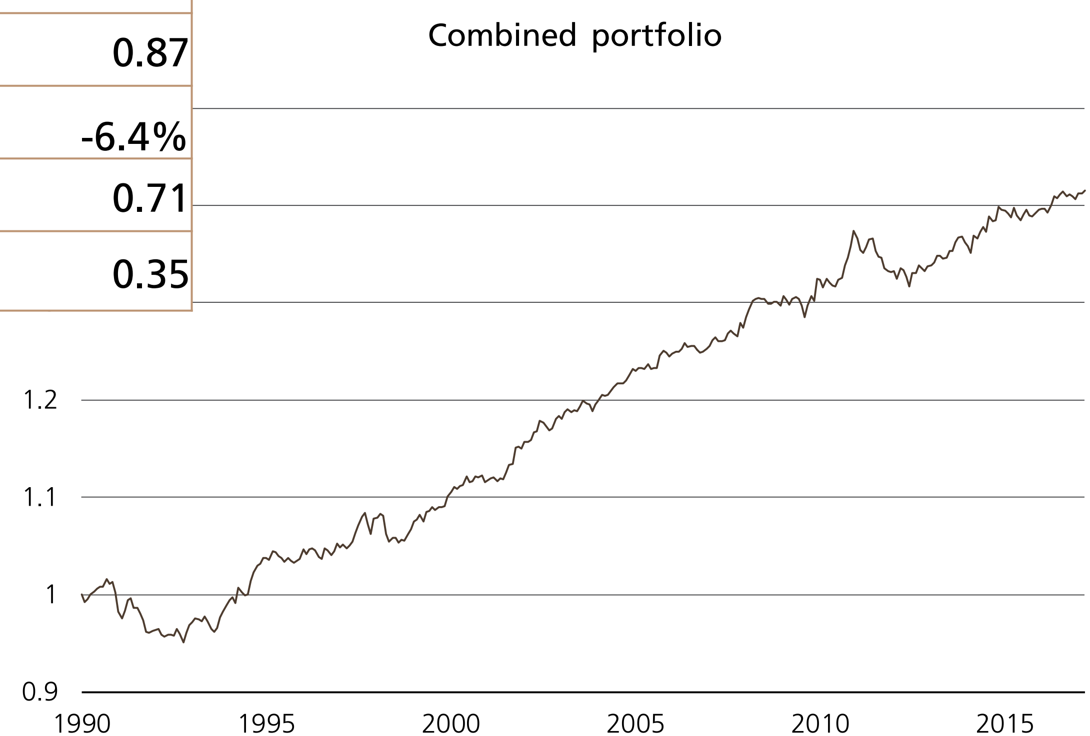
Source: UBS Quantitative Research

For illustrative purposes only

Combined portfolio

Sample: 1991M01 – 2018M02	Combined
Average Geometric Return (%)	1.3%
Average Arithmetic Return (%)	1.3%
Annualised Volatility (%)	1.8%
Skewness	-0.03
Kurtosis	0.87
Maximum Drawdown (%)	-6.4%
Sharpe Ratio (annualised)	0.71
Sortino Ratio (annualised)	0.35

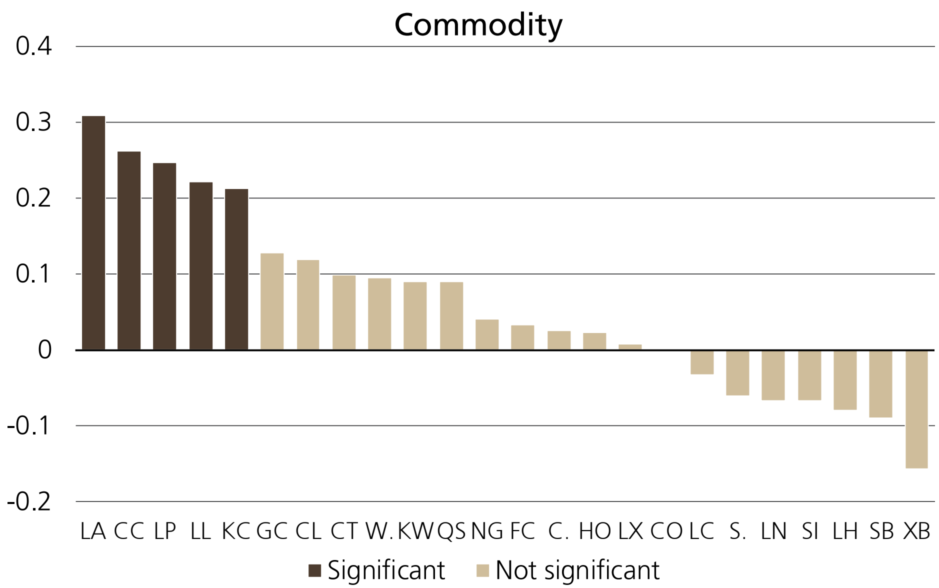


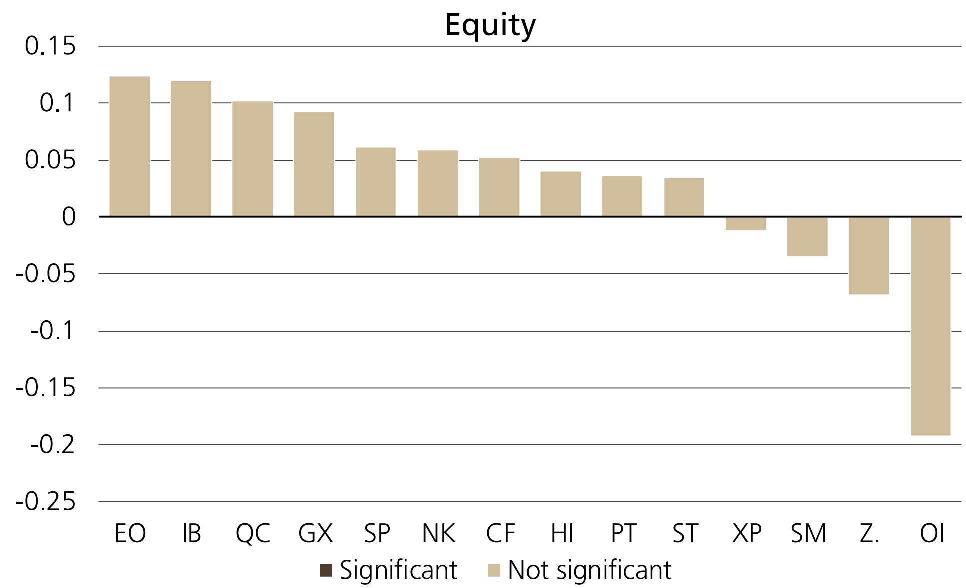
Source: UBS Quantitative Research. Portfolios are combined using 1/vol weighting using an EWMA volatility measure. For illustrative purposes only

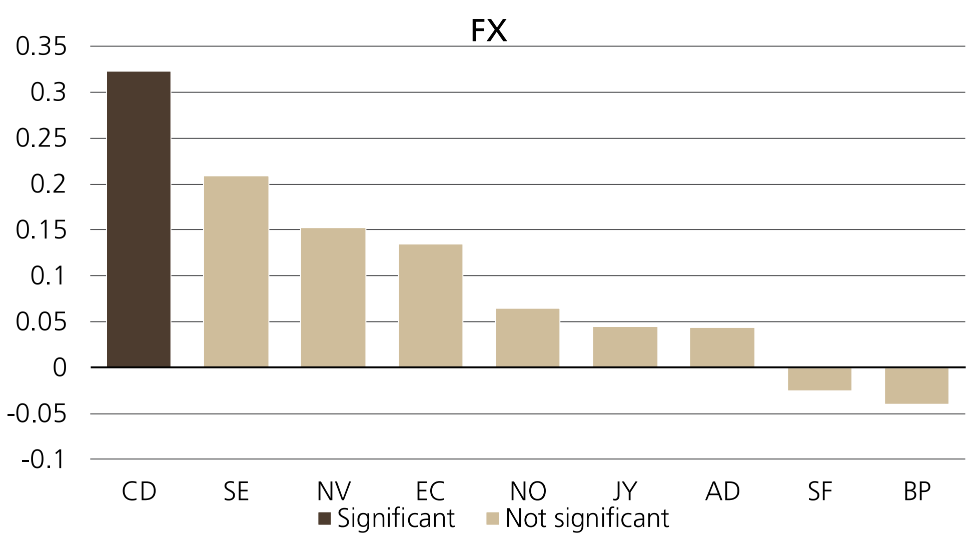
Is skewness persistent?

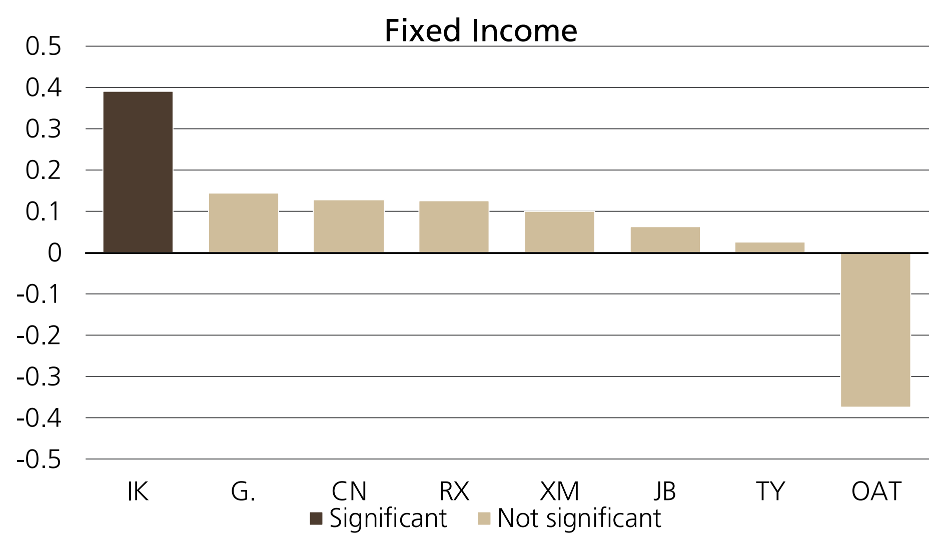
- It is interesting to see that although we are going long negatively skewed assets and short positively skewed assets the overall portfolio has a skewness close to zero.   This leads to the (obvious) question of whether skewness persists from period to period.
- To test this we calculate (non-overlapping) quarterly auto-correlations of skewness.
- There are more commodities than we would expect which show significant auto-correlation at the 5% level, and over all 55 assets we see 7 having significant auto-correlations (which is greater than the 3 we would expect by chance).
- Also only 14 of the 55 have negative correlations.
- So there is perhaps weak evidence of persistence, but primarily in commodity futures.

Is skewness persistent?









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Source: UBS Quantitative Research. Bars show the quarter-on-quarter correlation of skewness. Highlighted bars are significant at the 5% level. X-axis shows the two letter futures code. For illustrative purposes only

Section 2.C

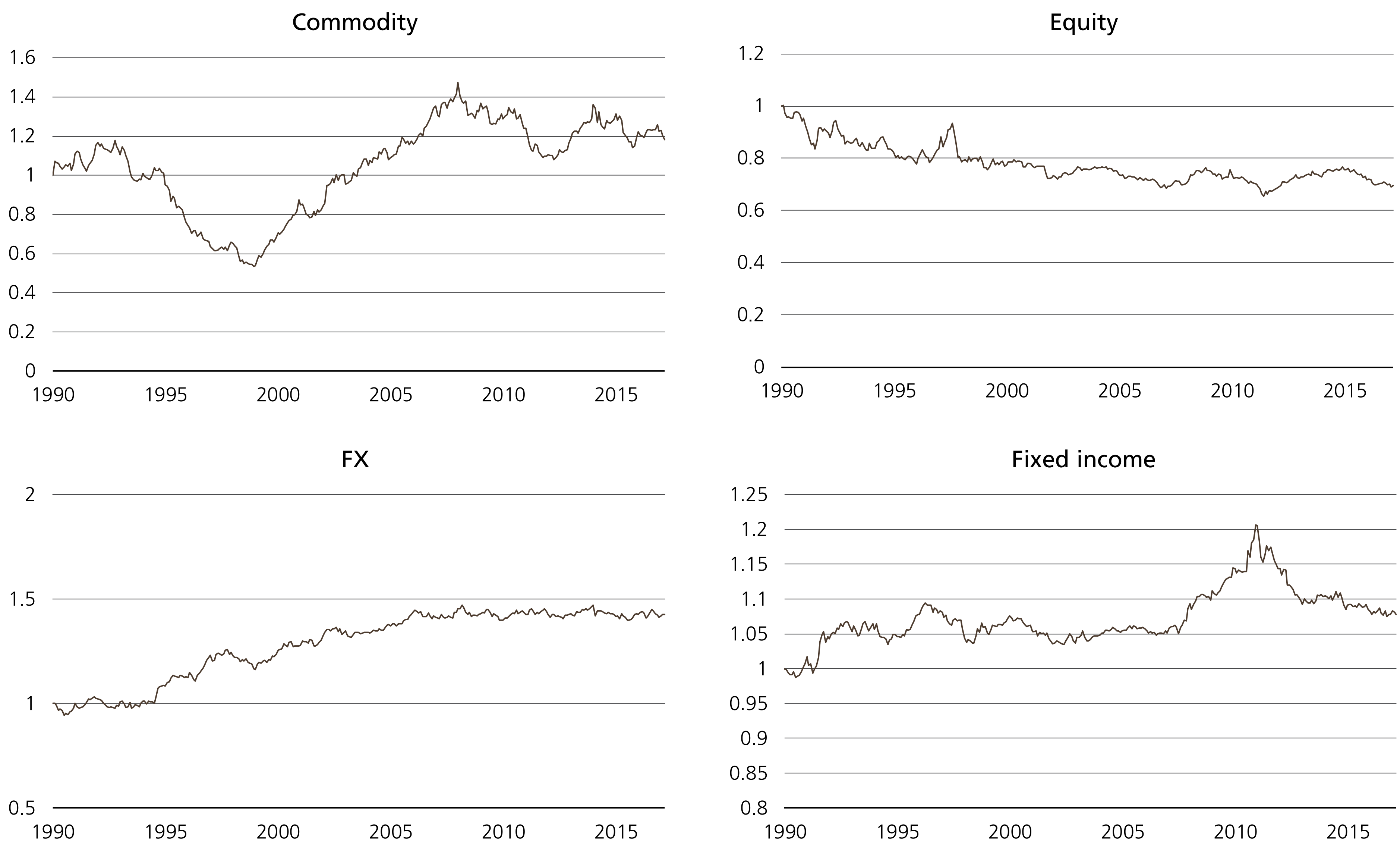
Moments

Kurtosis

Kurtosis

- What about kurtosis? The same argument for skewness should hold – people prefer assets with lower kurtosis, so they should reward this.
- However as we see below, the results are not that impressive.
- The combined portfolio has a Sharpe ratio of only 0.19.

Cross asset kurtosis by asset class



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Source: UBS Quantitative Research

For illustrative purposes only

Cross asset kurtosis by asset class

Sample: 1991M01 – 2018M02	Commodities	Equity Indices	FX	Govt. Bonds
Average Geometric Return (%)	0.6%	-1.3%	1.3%	0.3%
Average Arithmetic Return (%)	1.0%	-1.2%	1.4%	0.3%
Annualised Volatility (%)	8.2%	5.2%	3.4%	2.0%
Skewness	0.15	-0.10	0.01	0.28
Kurtosis	0.97	2.19	1.19	2.33
Sharpe Ratio (annualised)	0.12	-0.22	0.40	0.15
Sortino Ratio (annualised)	0.05	-0.09	0.18	0.06
Correlation Matrix				
Commodities	1			
Equity Indices	0.00	1		
FX	0.05	-0.02	1	
Govt. Bonds	0.02	0.06	0.06	1

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Source: UBS Quantitative Research

For illustrative purposes only

Section 2.D

Moments

Co-skewness and co-kurtosis

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Co-skewness

- As previously mentioned, co-skewness should be something that investors care about
- The definition of co-skewness is

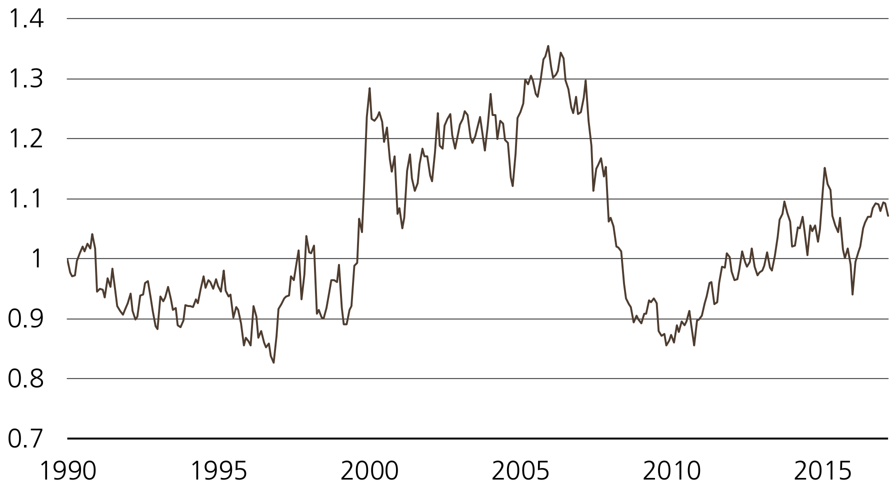
$$\frac{Cov(R_{i,t}, {R_{m,t}}^2)}{E\left[\left(R_{m,t} - E(R_{m,t})\right)^3\right]}$$

where $R_{i,t}$ is the asset return and $R_{m,t}$ is the market / portfolio return.

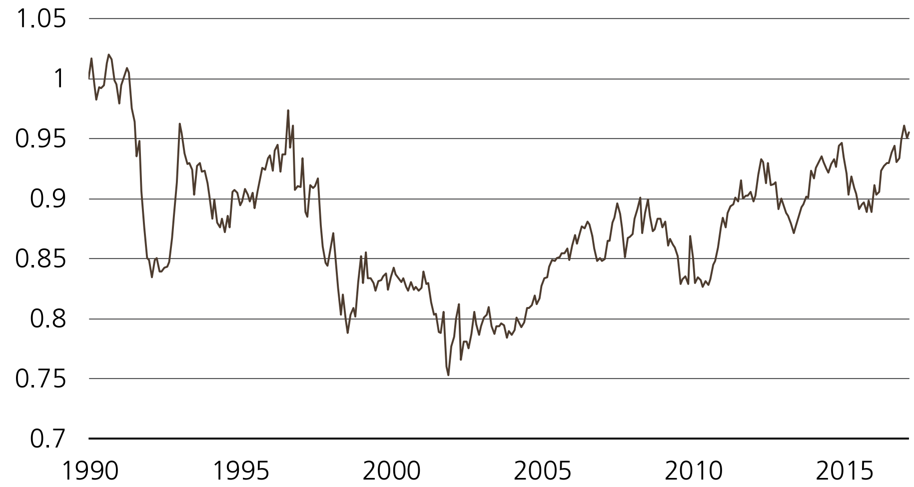
- But what should one use as the market?
- We try two approaches – we use an equal weighted portfolio of the asset class, or the equity market (as for many investors this is the largest source of their risk in their portfolio).
- The results below are against their own market; the results against equities were similar except for FX where the Sharpe ratio rises to 0.33 from 0.2.

Cross asset co-skewness against own asset market

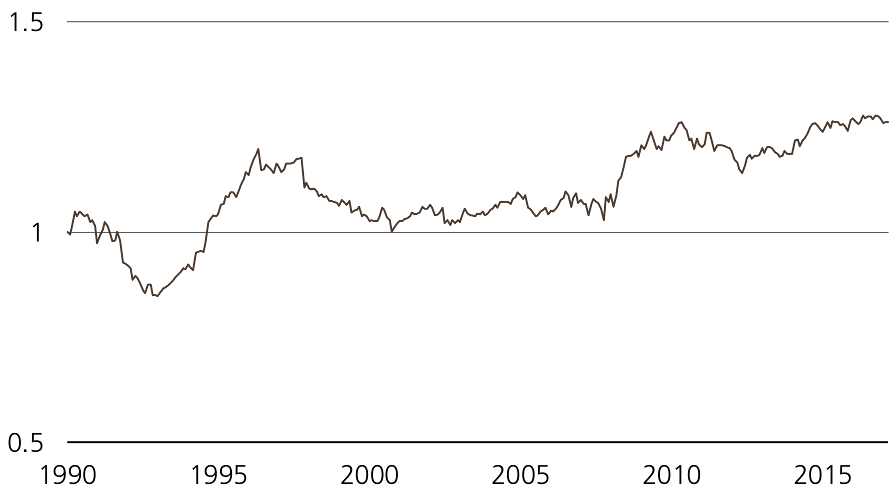
Commodity



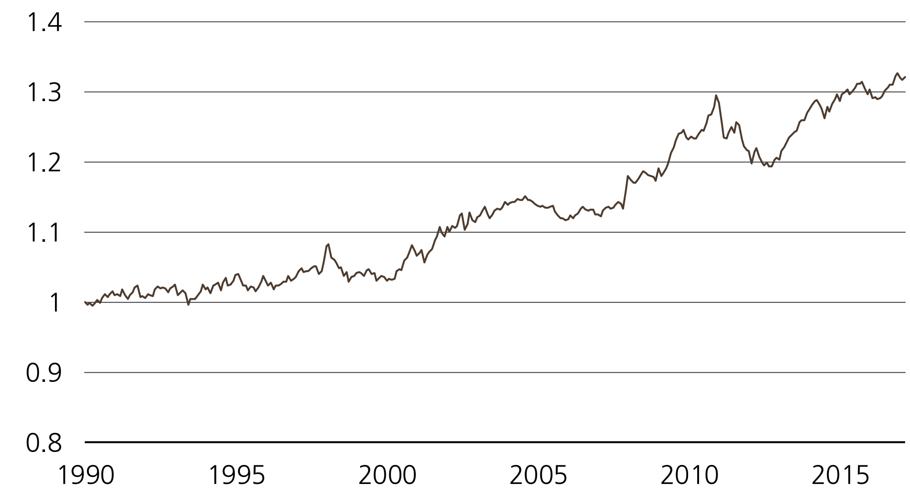
Equity



FX



Fixed income



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Source: UBS Quantitative Research

For illustrative purposes only

Cross asset co-skewness by asset class

Sample: 1991M01 – 2018M02	Commodities	Equity Indices	FX	Govt. Bonds
Average Geometric Return (%)	0.3%	-0.2%	0.9%	1.0%
Average Arithmetic Return (%)	0.7%	-0.0%	1.0%	1.0%
Annualised Volatility (%)	9.6%	5.4%	4.7%	2.3%
Skewness	-0.03	-0.41	-0.28	-0.34
Kurtosis	1.58	1.64	3.22	0.98
Maximum Drawdown (%)	-23%	-14%	-17%	-8%
Sharpe Ratio (annualised)	0.07	-0.01	0.21	0.46
Sortino Ratio (annualised)	0.03	-0.00	0.09	0.20
Correlation Matrix				
Commodities	1.00			
Equity Indices	0.07	1.00		
FX	0.03	0.06	1.00	
Govt. Bonds	-0.06	0.11	0.03	1

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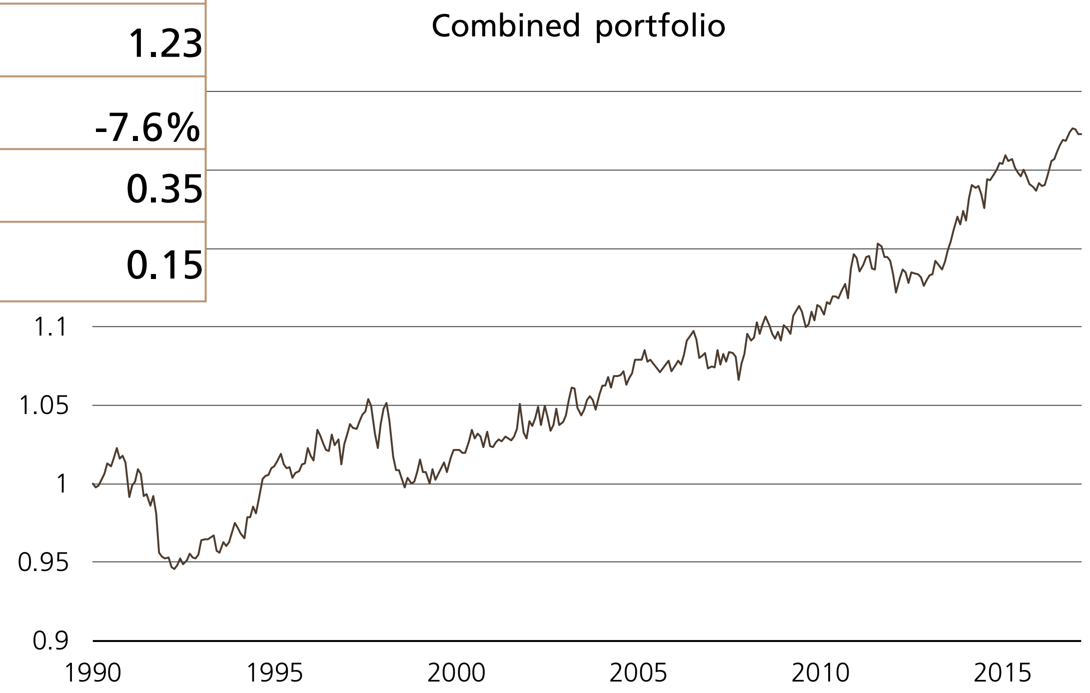
Source: UBS Quantitative Research

For illustrative purposes only

Combined portfolio

Sample: 1991M01 – 2018M02	Combined
Average Geometric Return (%)	0.7%
Average Arithmetic Return (%)	0.8%
Annualised Volatility (%)	2.2%
Skewness	-0.43
Kurtosis	1.23
Maximum Drawdown (%)	-7.6%
Sharpe Ratio (annualised)	0.35
Sortino Ratio (annualised)	0.15



Source: UBS Quantitative Research. Portfolios are combined using 1/vol weighting using an EWMA volatility measure. For illustrative purposes only.

Co-kurtosis

- The definition of co-kurtosis is

$$\frac{Cov(R_{i,t}, R_{m,t}{}^{3})}{E\left[\left(R_{m,t} - E(R_{m,t})\right)^{4}\right]}$$

  where $R_{i,t}$ is the asset return and $R_{m,t}$ is the market / portfolio return.

- This was not particularly successful so we don't report the results.

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Conclusion

- Low risk investing continues to be effective in equity futures; it is less so in the other asset classes.
- Investing in a basket of low skewness futures and shorting the high skewness ones is a successful strategy in all four asset classes
- Kurtosis and the two co-moments don’t appear to be successful investment strategies.

Section 3

Economic momentum

Introduction

- Most currency momentum strategies consider simply the returns to the currencies themselves: buy the currency that has appreciated over some period.
- In "Economic Momentum and Currency Returns“ by Magnus Dahlquist and Henrik Hasseltoft they analyse a currency momentum strategy which buys the currency of countries where the macroeconomic momentum is strong and shorts that where the momentum is weak.
- The paper considers the period from 1976-2014 and finds that this strategy exhibits annualised Sharpe ratios close to one over this period; we ask the question whether the strategy has continued to work.

Data

- The authors' main results are based on a 20 currency portfolio. We analysed a smaller universe of the G10 currencies (Australia, Canada, Eurozone, Japan, New Zealand, Norway, Sweden, Switzerland and the UK) against the USD from May 2002 until Feb 2018.

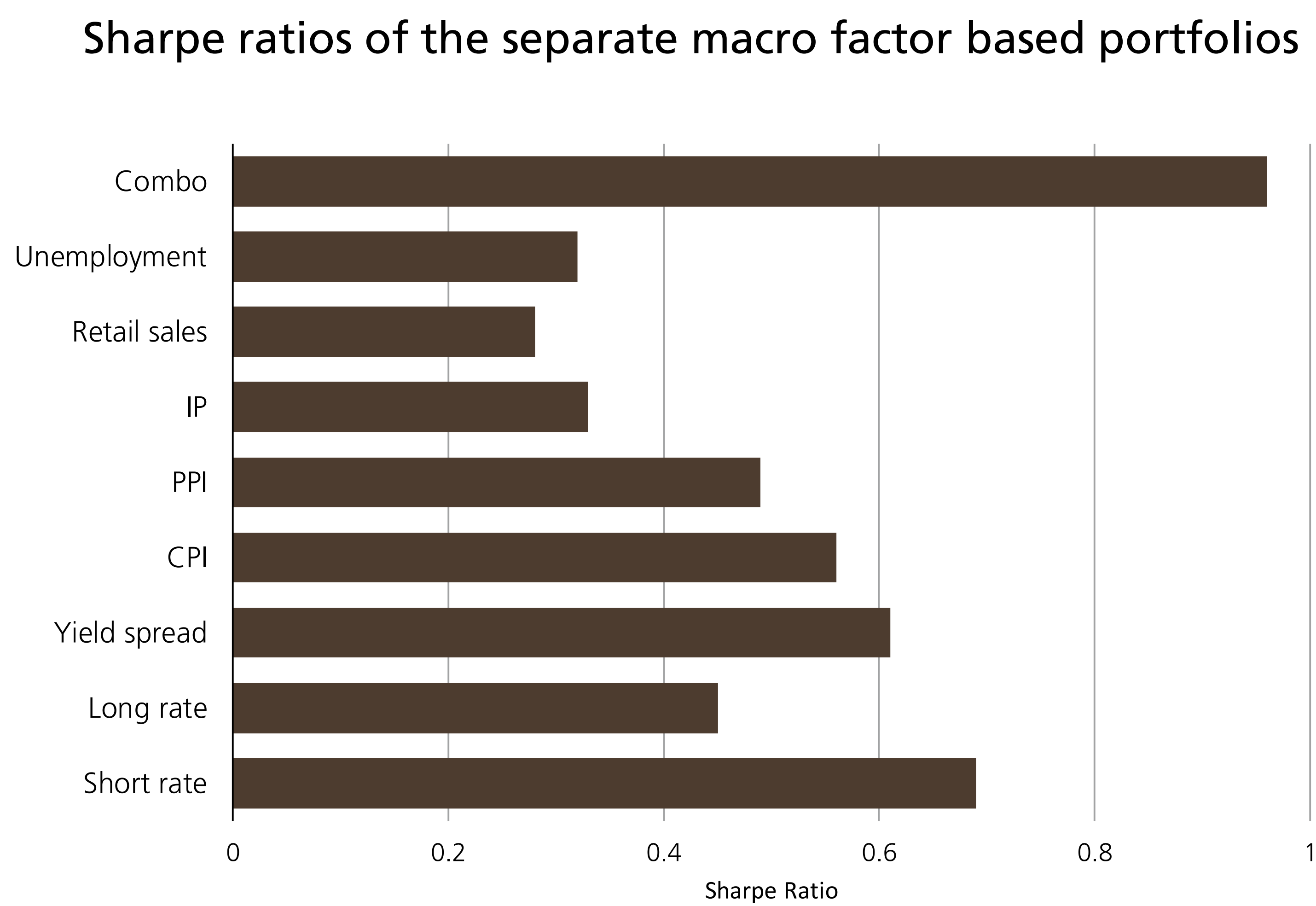
Variable	Measure / direction	Direction
10 year rates	Difference	Increasing
1 month rates	Difference	Increasing
Yield spreads (short – long)	Difference	Flatter
Consumer prices	Log change	Increasing
Producer prices	Log change	Increasing
Industrial production	Log change	Growth
Retail sales	Log change	Growth
Unemployment rate	Difference	Decreasing

Source: UBS Quantitative Research / Economic Momentum and Currency Returns by Dahlquist et al. Used with permission.

Portfolio construction

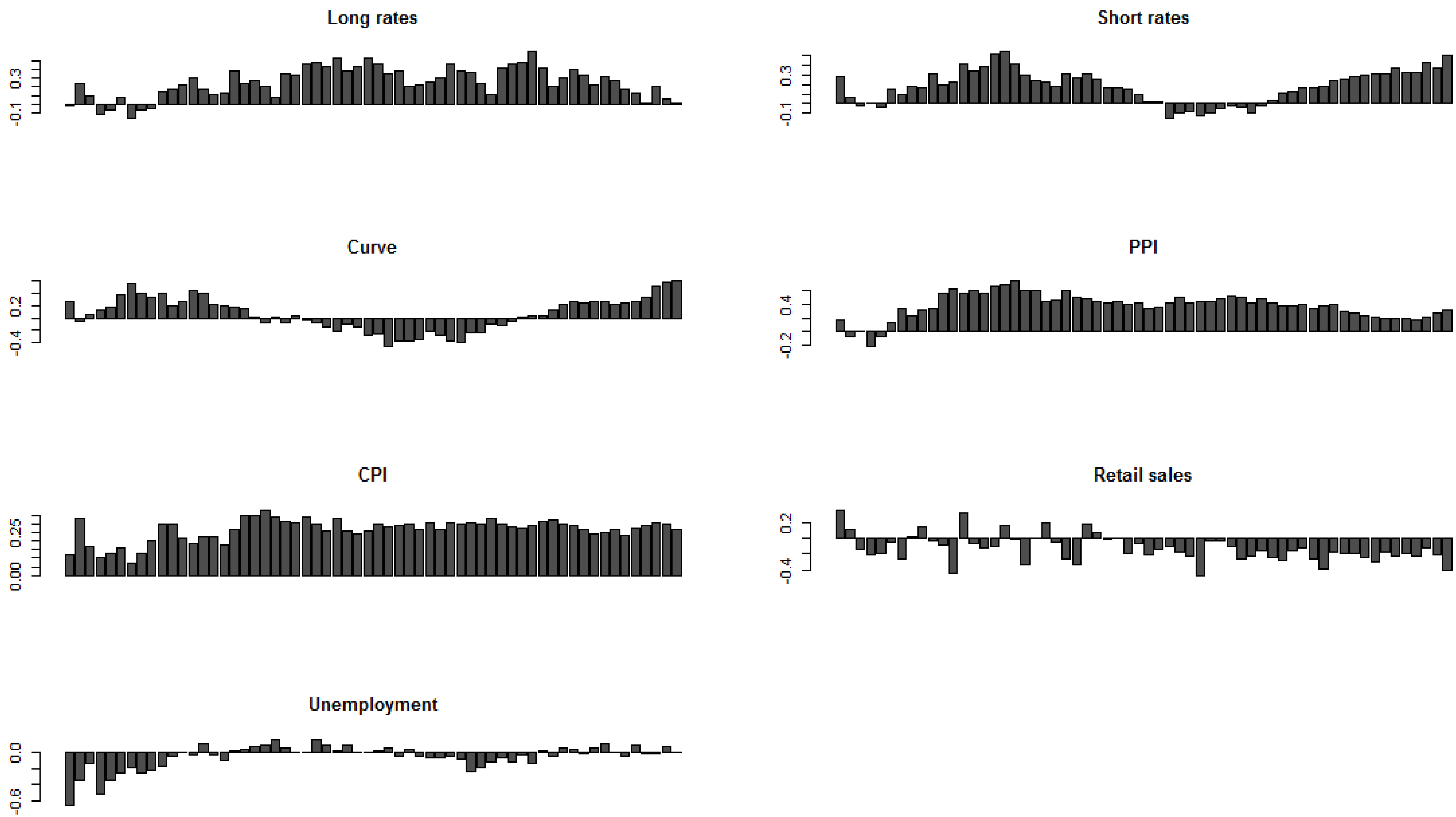
- As above the individual portfolios are constructed using demeaned-rank weighting, rebalanced monthly.
- Lookback periods of between 1 and 60 months are used, creating 480 separate portfolios.   The lookback periods are divided into short- (1-12 months), medium- (13-36 months) and long-term (37-60 months) groups.
- When combining the portfolios we use inverse volatility weighting (calculated over the previous three years).
- Apart from the interest rate based measures the economic data is lagged by 3 months to ensure that it is available.

Results from the paper



Source: Economic Momentum and Currency Returns by Dahlquist et al. Used with permission.

Sharpe Ratios by Strategy / Lookback



Source: UBS Quantitative Research. Data from May 2005 to Feb 2018. The lags are from 1 to 60 months. The non-interest rate data is lagged by 3 months. For illustrative purposes only.

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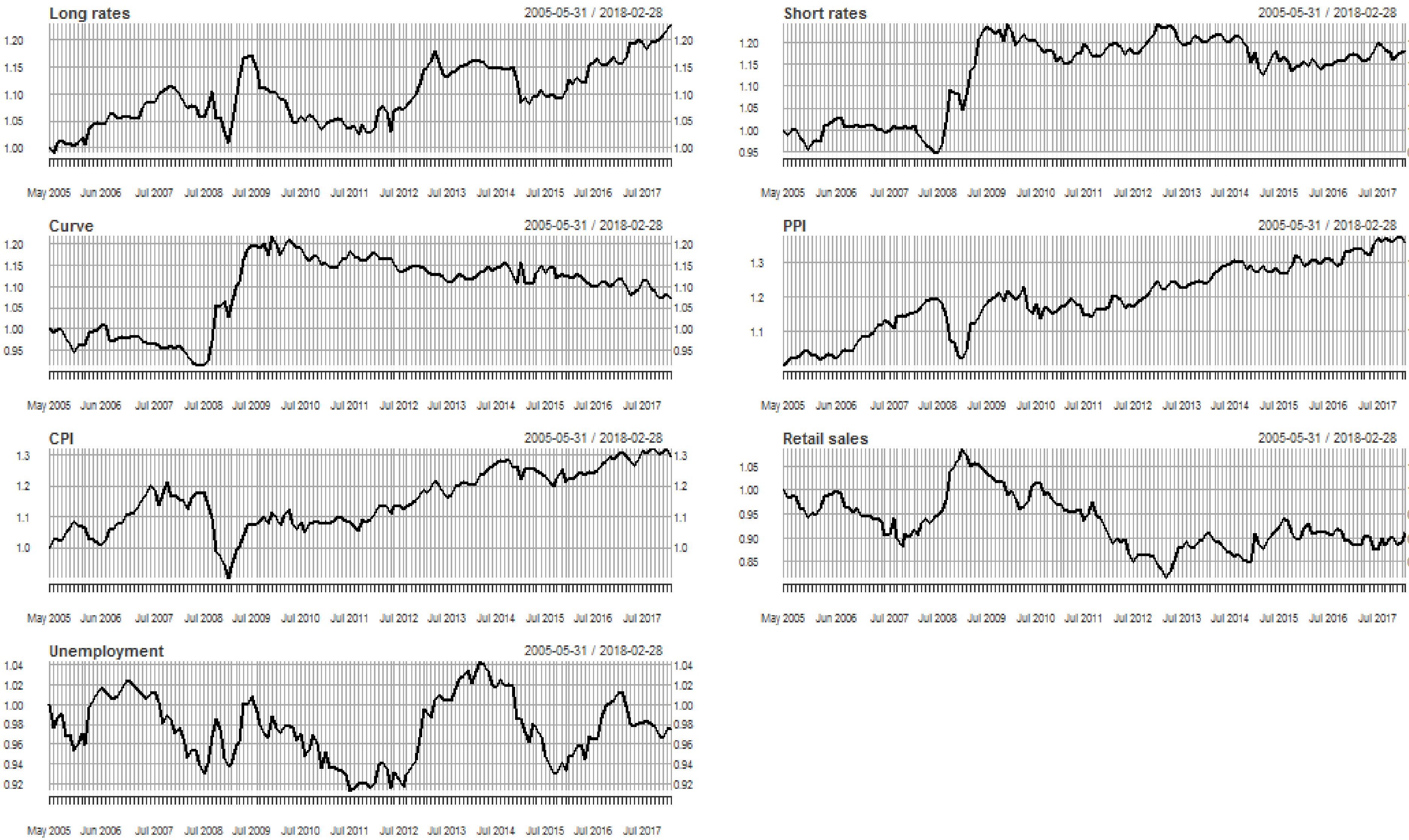
Returns by macroeconomic variable



Source: UBS Quantitative Research. Data from May 2005 to Feb 2018. Subportfolios are combined using 1 / volatility weighting. For illustrative purposes only.

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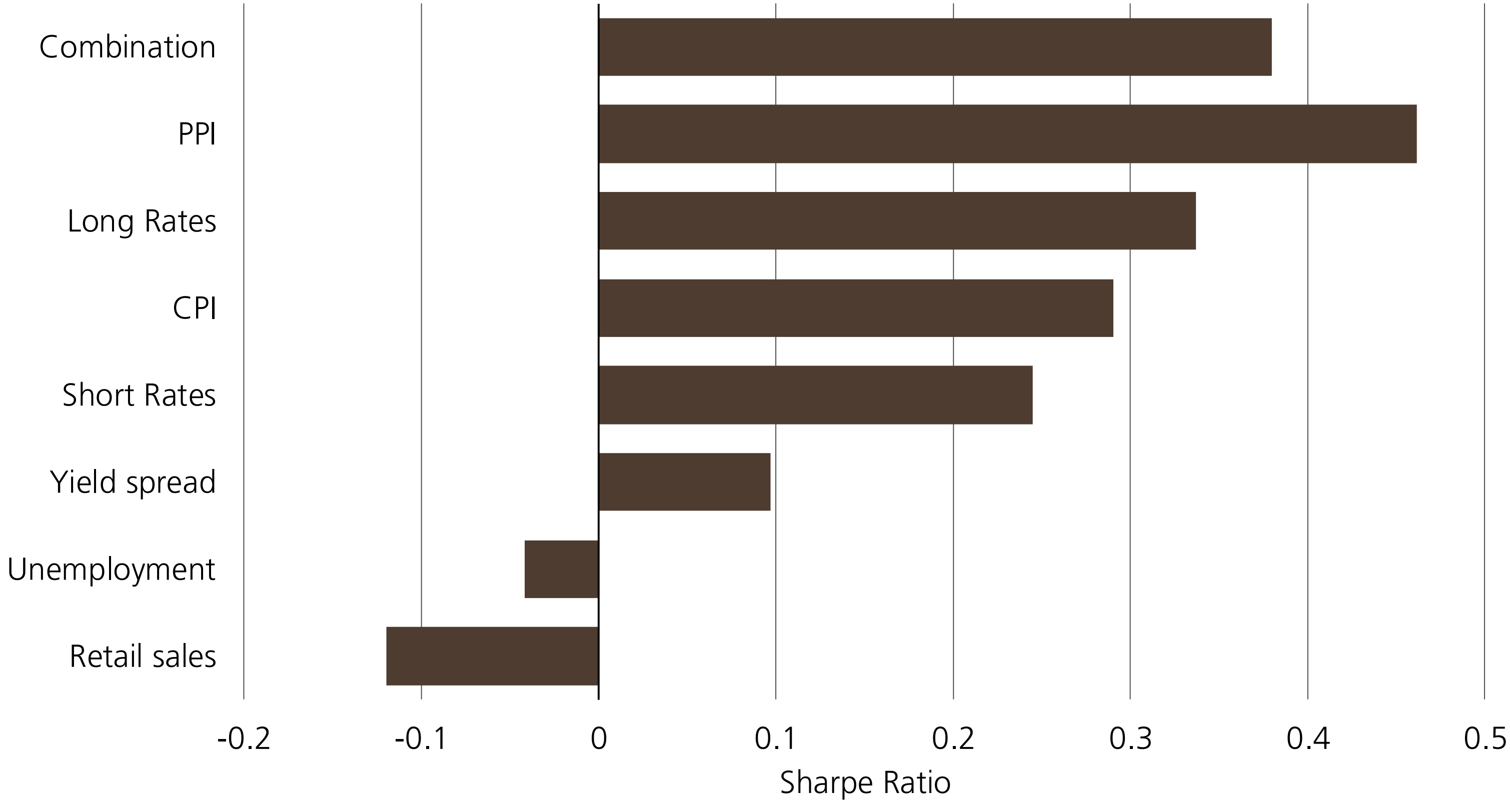
Sharpe ratios by macroeconomic variable

- **PPI is the most successful variable in our backtest; unemployment and retail sales lose money.**



Source: UBS Quantitative Research. Data from May 2005 to Feb 2018. Subportfolios are combined using 1 / volatility weighting. For illustrative purposes only .

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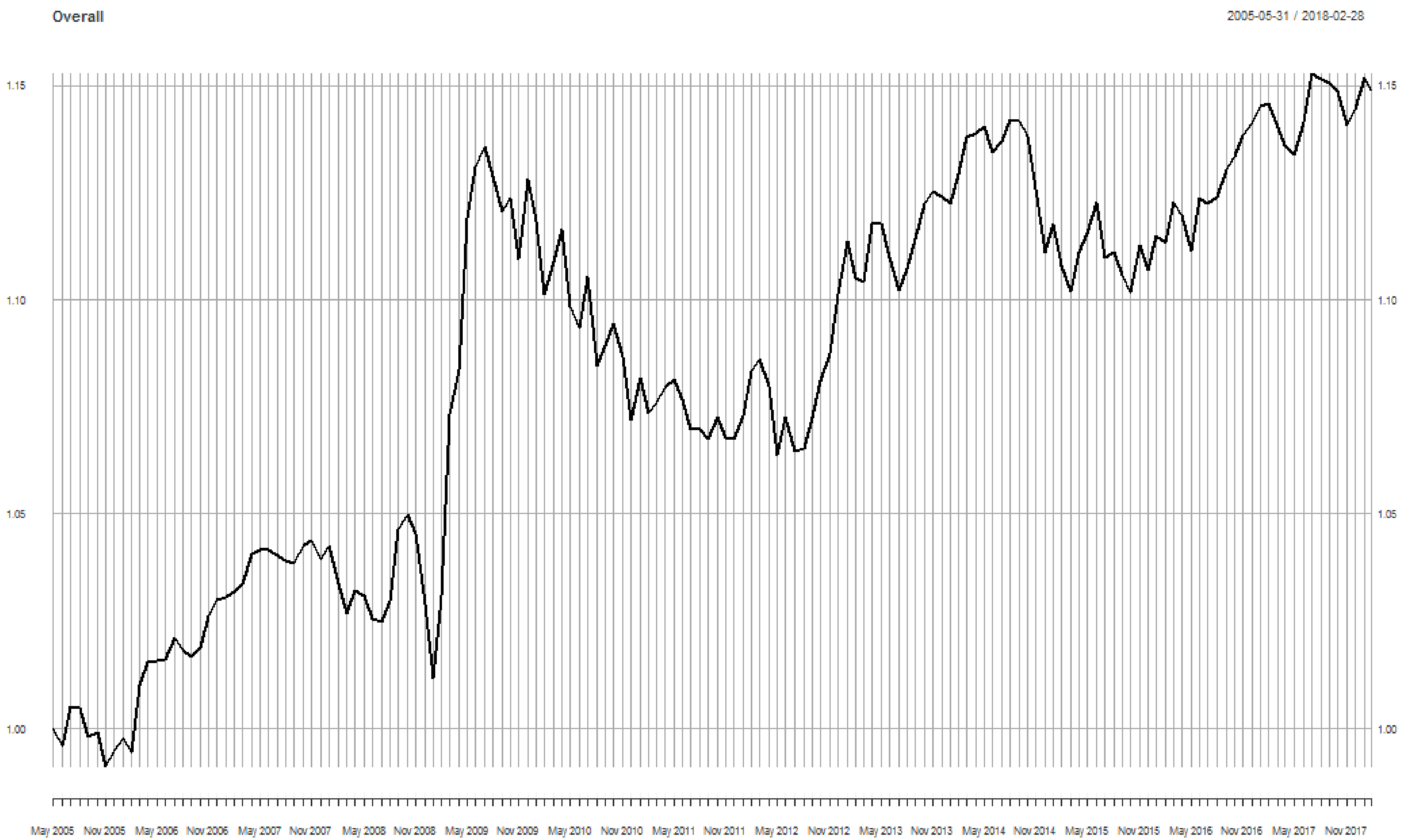
Overall returns



Source: UBS Quantitative Research. Data from May 2005 to Feb 2018. Subportfolios are combined using 1 / volatility weighting. For illustrative purposes only.

Summary statistics

Performance Statistics of Overall Portfolio

Annualized Return (Geometric %)	1.09%
Annualized Return (Arithmetic %)	1.13%
Volatility (%)	2.85%
Skewness	0.87
Kurtosis	3.97
Max Drawdown (%)	-6.33%
Annualized Sharpe Ratio	0.38
Calmar Ratio	0.17

Source: UBS Quantitative Research. The figure reports various performance statistics using monthly excess returns for the overall combined portfolio, where the individual portfolios are weighted using 1/vol weighting. The Calmar ratio is defined as the annualised geometric mean return over the maximum drawdown. The sample period is May 2005 to Feb 2017. For illustrative purposes only.

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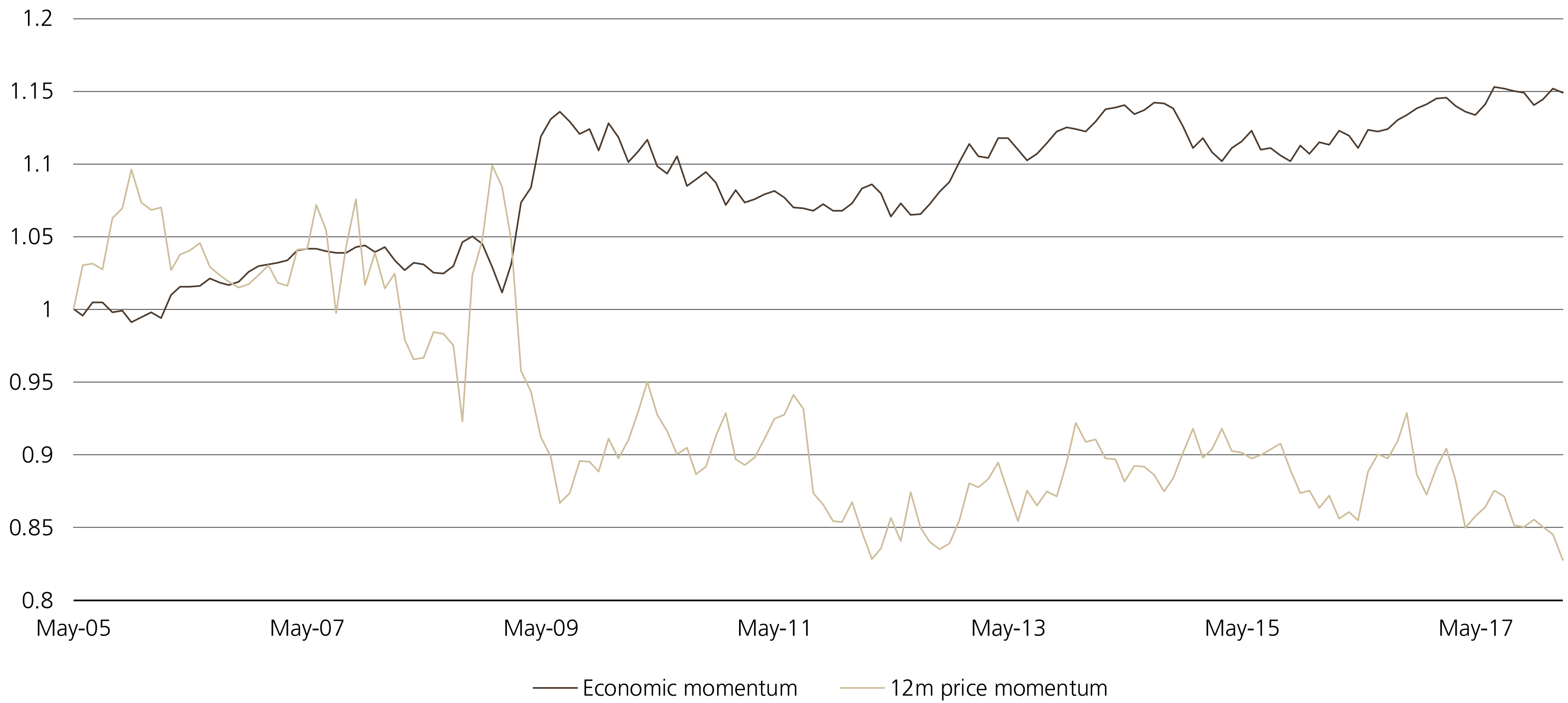
Is this just price momentum in disguise?

- No! The correlation between the returns over the period is -0.3. The paper finds the economic momentum subsumes the returns to carry.



Source: UBS Quantitative Research. Data from May 2005 to Feb 2018. Price momentum portfolio uses 12m momentum and demeaned rank weighting.

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Conclusion

- The results are less impressive than the paper reports – a Sharpe ratio of 0.3 against the 0.81 found by the authors for the G10 currencies.
- The retail sales and unemployment based strategies were particularly disappointing. Removing these from the combined strategy gives us a Sharpe of 0.48.
- However over this sample period the strategy outperforms a simple price momentum strategy, and so is worth monitoring.

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Appendix A

Asset universe

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Futures universe

Commodities		Bonds - all 10 year	FX	Equity
WTI Crude Oil	HRW Wheat	US	EUR	S&P 500
Brend Crude Oil	Cocoa	Australia	JPY	Toronto 60
ULS Diesel	Copper	Canada	GBP	DAX
Gasoline	Aluminium	Euro-Bund	AUD	FTSE 100
Gasoil	Zinc	UK	CAD	Nikkei 225
Natural Gas	Nickel	France	CHF	ASX 200
Soybeans	Lead	Italy	NZD	Hang Seng
Sugar #11	Gold		SEK	Spain IBES
Corn	Silver		NOK	Switzerland SMI
SRW Wheat	Live Cattle			CAC 40
Cotton	Lean Hogs			Oslo OBX
Coffee	Feeder Cattle			Netherlands AEX
				Italy FTSE MIB
				Stockholm OMXS

Source: UBS

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Neutral	FSR is between -6% and 6% of the MRA.	39%	24%
Sell	FSR is > 6% below the MRA.	16%	13%
Short-Term Rating	**Definition**	**Coverage[3]**	**IB Services[4]**
Buy	Stock price expected to rise within three months from the time the rating was assigned because of a specific catalyst or event.	<1%	<1%
Sell	Stock price expected to fall within three months from the time the rating was assigned because of a specific catalyst or event.	<1%	<1%

Source: UBS. Rating allocations are as of 31 December 2017.
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