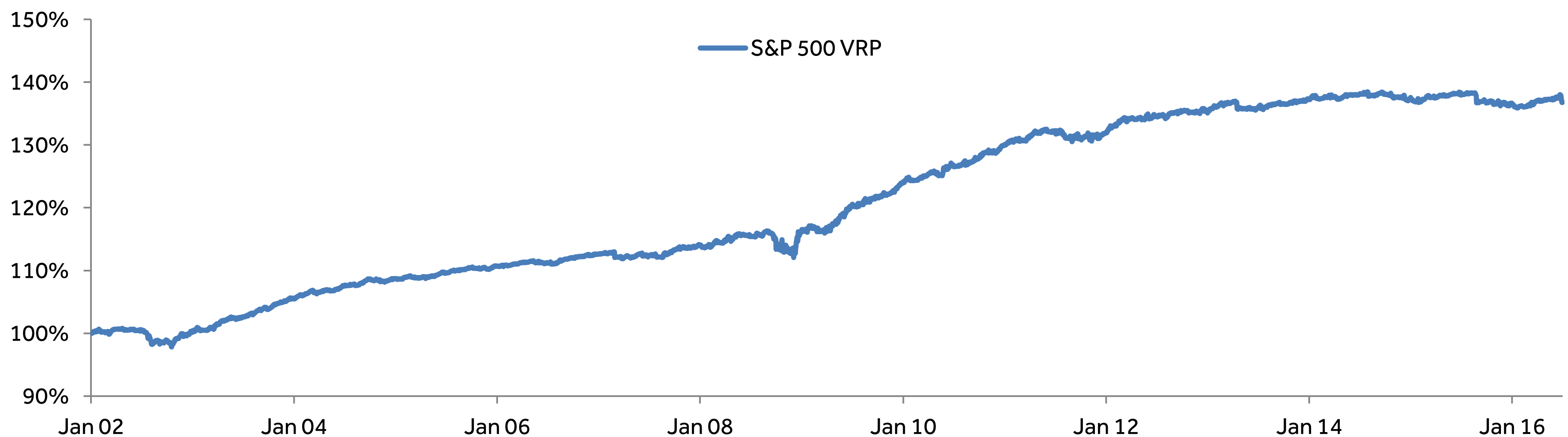
FULCRUM

Multi Asset Variance Risk Premium

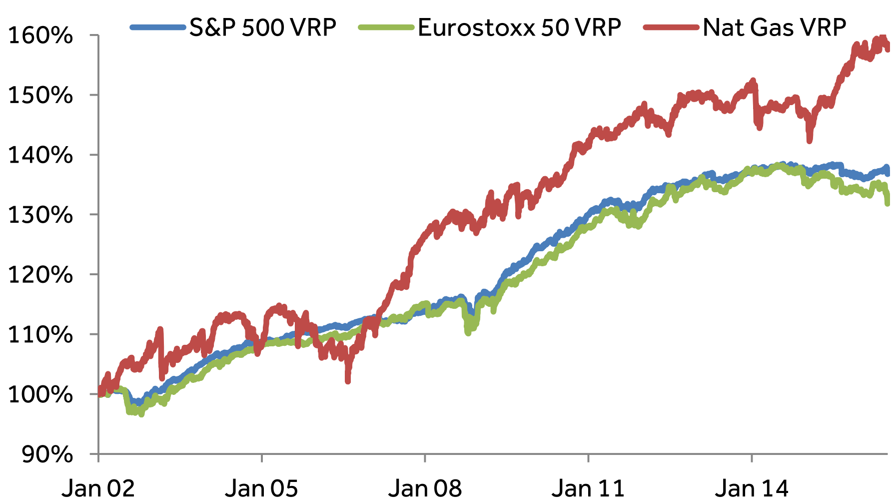
The S&P 500 Variance Risk Premium

- The S&P 500 variance risk premium (VRP) is well known in market and academic circles:
    - Capture methodology is an important consideration.
    - Trading and market impact costs are a significant factor. In the VIX, 50% of the VRP available from a delta hedged straddle maybe consumed by costs. Most assets sit in the 20% and 30% range.
- Asymmetry of returns is fundamental to the risk premium, but this profile is a deterrent to investment for many potential investors:
    - Can a shift to a multi asset approach improve the risk return and drawdown profile?



S&P 500, Eurostoxx 50 and natural gas

- The first step towards diversification is to broaden the equity basket:
  - Since 2002, the correlation between Eurostoxx 50 and S&P 500 has been 85%, whilst the correlation between the VRPs is 72%.
- The real benefits emerge from a move to a multi asset basis:
  - The correlation between the S&P 500 and natural gas VRPs is only 2%.
- Diversifying the portfolio increases the information ratio and reduces the maximum drawdown.

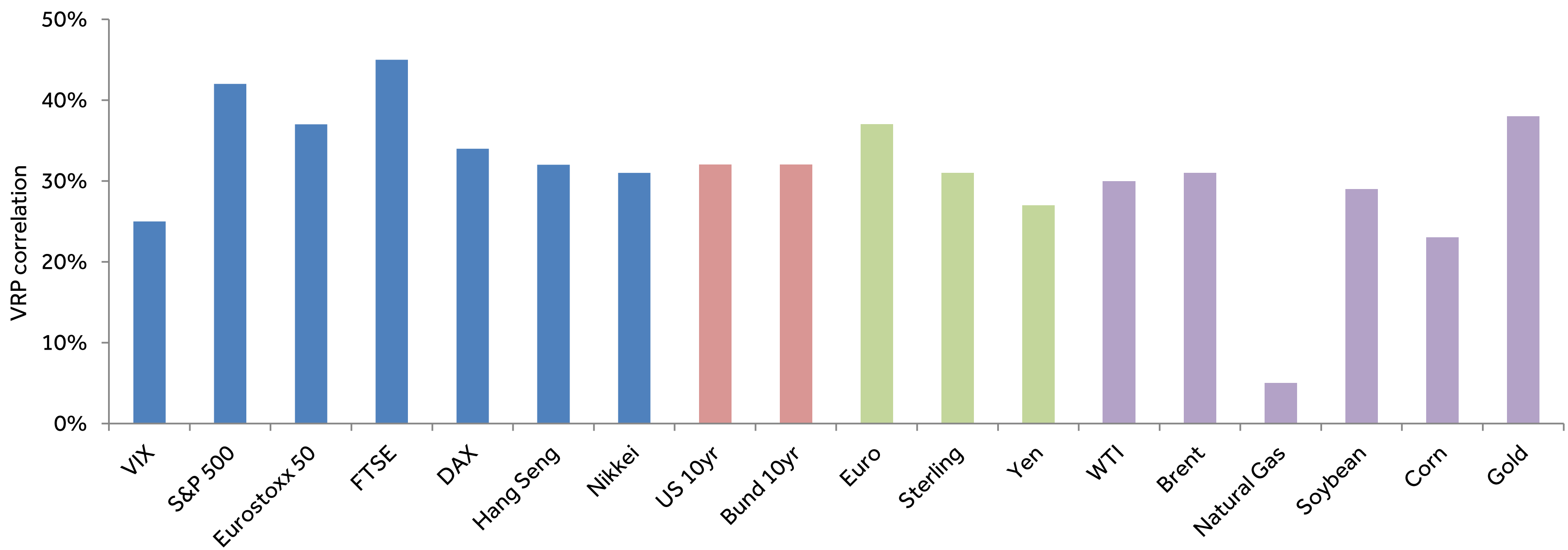


	S&P 500	Eurostoxx 50	Nat Gas	Equity	Equity + Nat Gas
Annualised Return	2.2%	1.9%	3.2%	2.1%	2.5%
Volatility	1.9%	2.2%	4.4%	1.7%	1.9%
Sharpe Ratio	1.1	0.9	0.7	1.2	1.3
Max Drawdown	-3.6%	-4.7%	-11.1%	-3.7%	-2.9%

Source: Fulcrum Asset Management LLP. Returns based on a monthly exposure of 10bp vega via Fulcrum's implementation methodology.

The correlation structure

- Correlation structure analysed by looking at the average correlation of an asset's VRP with the VRP of other assets:
  - Average correlation between asset VRPs is only 31%.
  - Equities and gold have higher than average correlations. Gold has acted as a risk on / risk off asset and equity correlation is elevated due to the high pairwise correlation between indices.
  - Commodities are the strongest diversifiers along with a surprise showing from VIX.



Source: Fulcrum Asset Management LLP. Correlations based on Fulcrum's implementation methodology.

A granular review of correlation structure

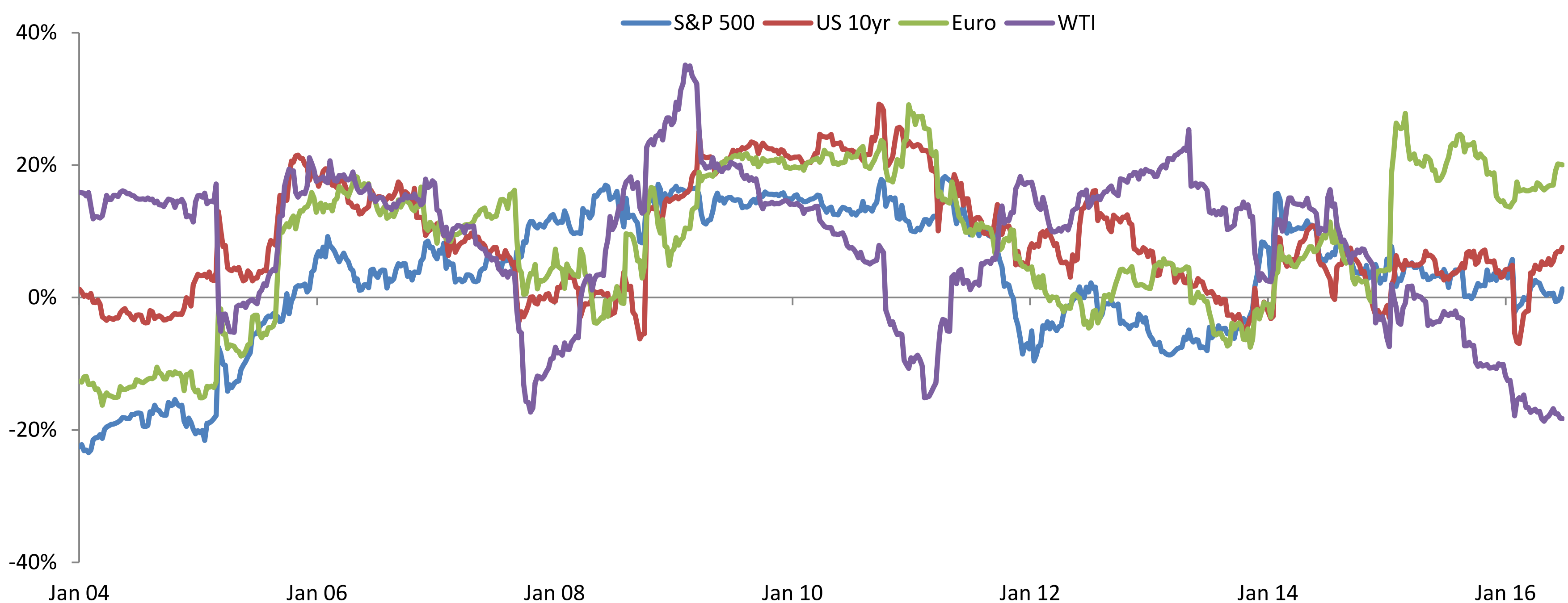
- The highlights:
  - Negative correlations between VRPs are unusual. Contrast this with bond / equity correlation.
  - Correlations between Western equity VRPs are high; inclusion of Asian markets is beneficial.
  - Correlations between VIX VRP and equity VRP's are surprisingly low.
  - WTI and Brent price correlation is over 90%, but VRP's only have an 80% correlation – diversification of expiry dates is beneficial.

	UX	ES	VG	Z	GX	HI	NK	TY	RX	EC	BP	JY	CL	CO	NG	S	C	GC
Average correlation	0.25	0.42	0.37	0.45	0.34	0.32	0.31	0.32	0.32	0.37	0.31	0.27	0.30	0.31	0.05	0.29	0.23	0.38
UX	1.00	0.34	0.14	0.19	0.07	0.11	0.21	0.26	0.31	0.18	0.23	0.33	0.20	0.17	0.03	0.23	0.18	0.25
ES	0.34	1.00	0.72	0.76	0.70	0.42	0.41	0.29	0.33	0.31	0.41	0.24	0.34	0.25	-0.01	0.26	0.23	0.50
VG	0.14	0.72	1.00	0.75	0.89	0.33	0.32	0.26	0.35	0.27	0.26	0.14	0.23	0.22	-0.06	0.24	0.23	0.47
Z	0.19	0.76	0.75	1.00	0.69	0.43	0.38	0.45	0.44	0.50	0.49	0.29	0.34	0.35	-0.05	0.29	0.21	0.63
GX	0.07	0.70	0.89	0.69	1.00	0.35	0.26	0.14	0.29	0.23	0.16	0.12	0.19	0.16	-0.06	0.24	0.21	0.41
HI	0.11	0.42	0.33	0.43	0.35	1.00	0.38	0.18	0.24	0.42	0.30	0.36	0.19	0.15	0.00	0.26	0.15	0.43
NK	0.21	0.41	0.32	0.38	0.26	0.38	1.00	0.34	0.23	0.30	0.29	0.48	0.14	0.13	0.04	0.19	0.23	0.29
TY	0.26	0.29	0.26	0.45	0.14	0.18	0.34	1.00	0.58	0.43	0.23	0.28	0.28	0.35	-0.07	0.28	0.10	0.33
RX	0.31	0.33	0.35	0.44	0.29	0.24	0.23	0.58	1.00	0.46	0.29	0.14	0.31	0.33	-0.06	0.15	0.07	0.25
EC	0.18	0.31	0.27	0.50	0.23	0.42	0.30	0.43	0.46	1.00	0.53	0.38	0.29	0.39	0.03	0.28	0.13	0.45
BP	0.23	0.41	0.26	0.49	0.16	0.30	0.29	0.23	0.29	0.53	1.00	0.20	0.17	0.14	0.15	0.22	0.18	0.39
JY	0.33	0.24	0.14	0.29	0.12	0.36	0.48	0.28	0.14	0.38	0.20	1.00	0.20	0.24	0.01	0.16	0.00	0.35
CL	0.20	0.34	0.23	0.34	0.19	0.19	0.14	0.28	0.31	0.29	0.17	0.20	1.00	0.80	0.02	0.37	0.15	0.27
CO	0.17	0.25	0.22	0.35	0.16	0.15	0.13	0.35	0.33	0.39	0.14	0.24	0.80	1.00	0.04	0.33	0.20	0.28
NG	0.03	-0.01	-0.06	-0.05	-0.06	0.00	0.04	-0.07	-0.06	0.03	0.15	0.01	0.02	0.04	1.00	-0.09	0.05	-0.04
S	0.23	0.26	0.24	0.29	0.24	0.26	0.19	0.28	0.15	0.28	0.22	0.16	0.37	0.33	-0.09	1.00	0.53	0.36
C	0.18	0.23	0.23	0.21	0.21	0.15	0.23	0.10	0.07	0.13	0.18	0.00	0.15	0.20	0.05	0.53	1.00	0.31
GC	0.25	0.50	0.47	0.63	0.41	0.43	0.29	0.33	0.25	0.45	0.39	0.35	0.27	0.28	-0.04	0.36	0.31	1.00

Source: Fulcrum Asset Management LLP. Correlations based on Fulcrum's implementation methodology.

How stable were these correlations?

- Analysis of the rolling 2 year correlation between Nat Gas VRP and the S&P 500, US 10yr, Euro and WTI VRPs reveals:
  - Correlations have sat within a band of 20% around 0%.
  - Correlations with "financial assets" have tended to move together.
- Nat Gas VRP has in the past offered a relatively stable diversification opportunity.



Source: Fulcrum Asset Management LLP. Correlations based on Fulcrum's implementation methodology.

Asset allocation

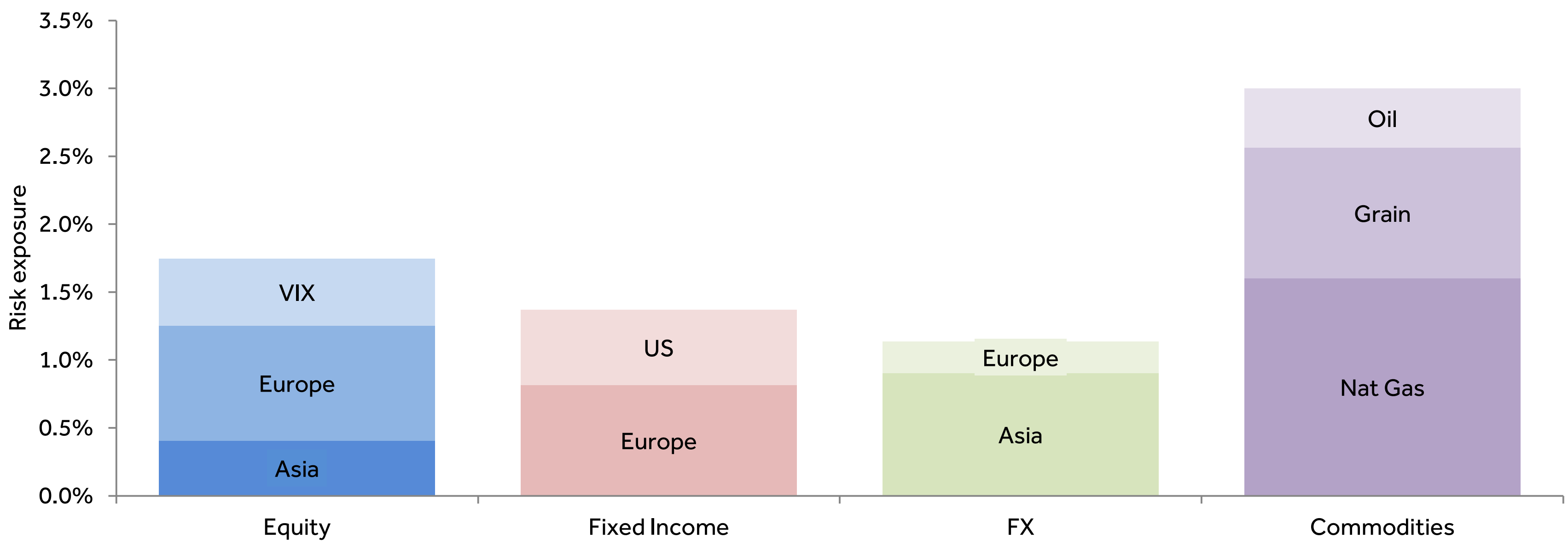
- There are numerous asset allocation techniques available.
- Equal Weight:
    - Simple but fails to differentiate between the very different volatility profiles of the individual VRPs.
- Equal volatility:
    - A risk parity approach with low risk strategies leveraged higher.
    - Approach ignores the benefits of diversification.
- Minimum variance, equal risk contribution, maximum diversification:
    - Requires an estimate of the correlation matrix. Are we confident enough in the forecast?
    - Can lead to high allocations to commodities and natural gas in particular.

An example

- A measure of diversification is an estimate of the number of orthogonal positions:

$$\text{Number of orthogonal assets} = \left(\sum w_i \sigma_i / \sigma_p\right)^2$$

- Optimising the asset allocation to maximise the benefits of diversification results in 4.7 orthogonal assets:
  - An unhealthy risk allocation to natural gas.
  - A heavy risk allocation to commodities.
  - The removal of the gold and US equity VRPs from the portfolio.

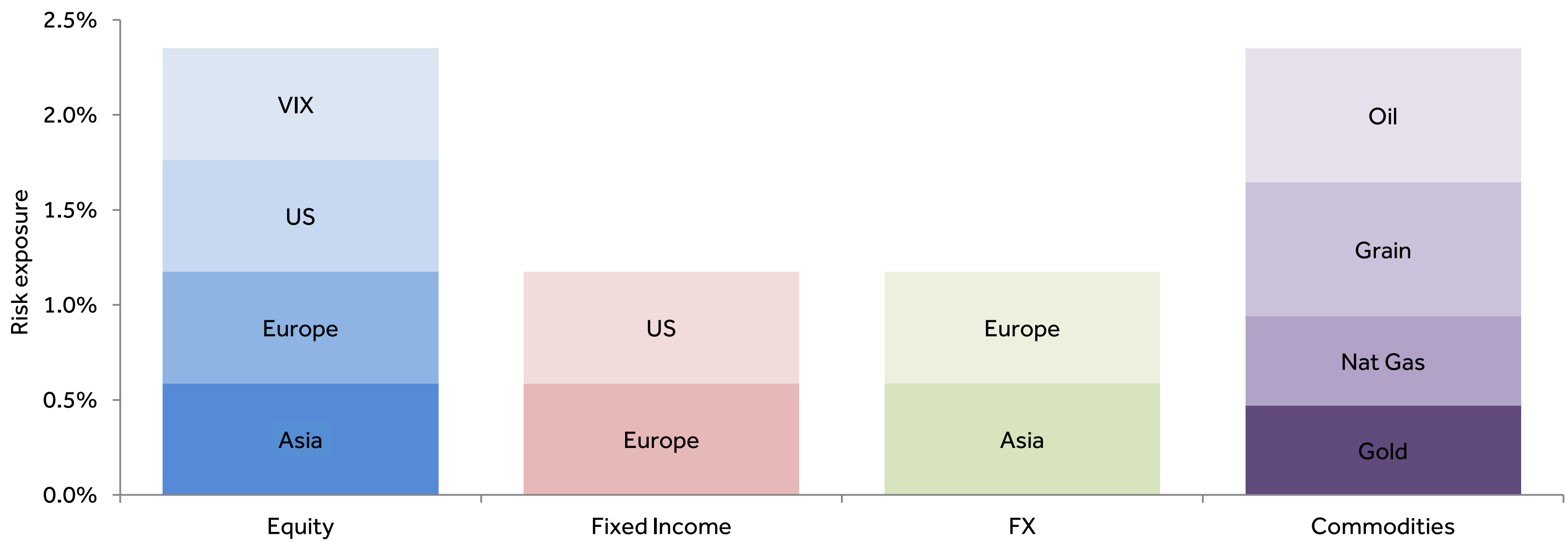


Source: Fulcrum Asset Management LLP.

The Fulcrum portfolio

Occam's razor – Among competing hypotheses, the one with the fewest assumptions should be selected.

- A risk parity approach is taken with 1/3 risk allocation given to each of equity, commodities and the combination of currency and fixed income.
- Number of orthogonal assets = 3.5
- Whilst asset allocation is very important, it is only one of several important variables in the process of maximising the VRP extraction.



Source: Fulcrum Asset Management LLP.

Should one exclude assets?

- Start with the premise that all option markets trade with an implicit VRP.
- To exclude an asset one of three conditions must be met:
  - **Cost**
    - There is a limited premium on offer and costs rapidly eat into the opportunity.
    - Bid offer on heating oil options is high. Correlation of 80% with Brent and WTI VRPs.
  - **Non free floating asset:**
    - Short option exposure may result in excessive gap risk being taken.
    - EURCHF implied traded at 2.6% in January 2015 before SNB removed the floor. Realised traded in excess of 30% after its removal.
  - **An unexplainably poor backtest:**
    - A controversial rational in the world of CTA.
    - AUD VRP has performed very poorly over the last decade. A function of it being a carry currency / China proxy?

Drawbacks of the multi asset approach

- Whilst the benefits to the investor are clear, there are clearly high research and operational costs associated with extending the strategy beyond the S&P 500:

- **Research:**

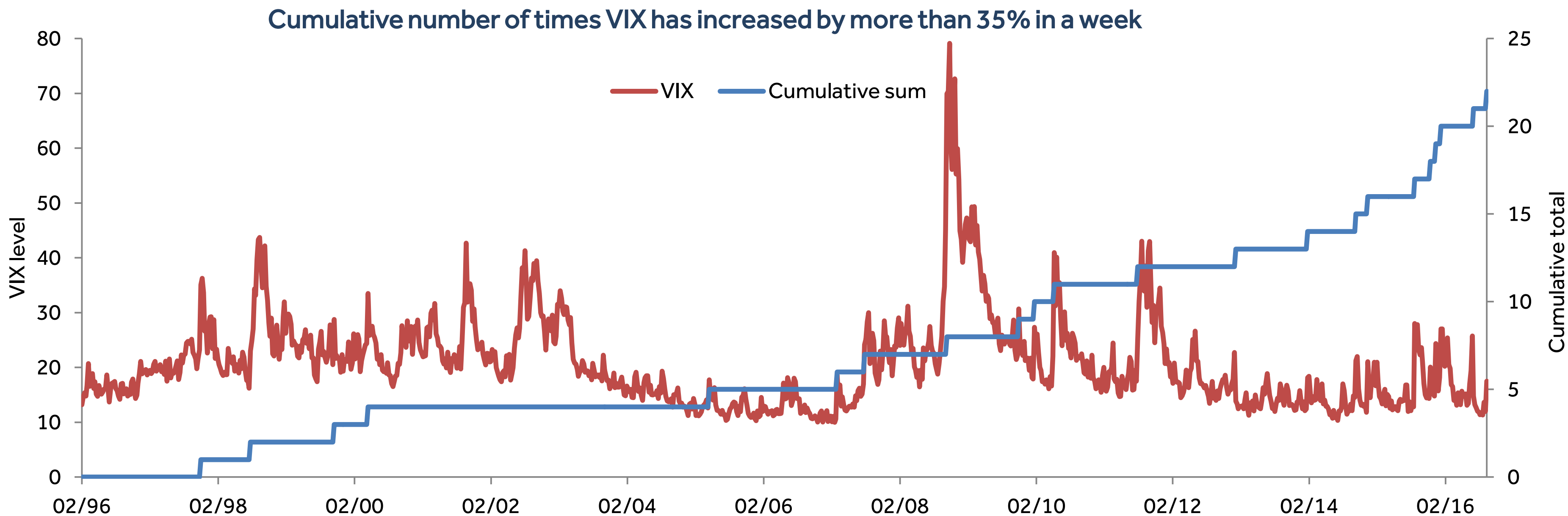
  - Does the VRP exhibit seasonality?
  - Impact of limit days?
    - In grains, this can have a significant impact on the realisable VRP.
  - New crop / old crop, standard or off cycle option expiry?

- **Operational:**

  - A minimum AUM level to warrant the complexity and ensure market efficiency.
  - Robust systems:
    - A S&P 500 straddle can be run on a spreadsheet, but that is not realistic for a multi asset VRP book.
  - Heavy demand on trading team to initiate / close / manage expiry of option positions. Delta hedging can be largely automated.

Is the VRP in decline?

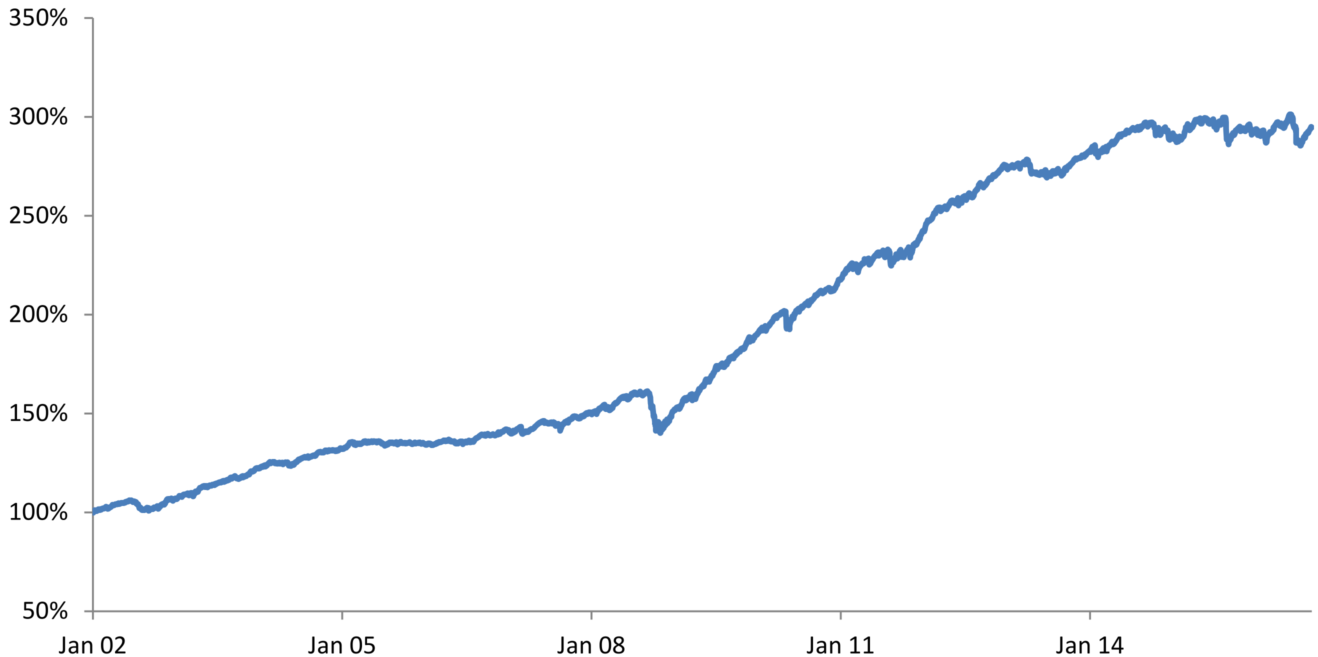
- The multi asset VRP has been weak for the last 3 years.
- Idiosyncratic risk is ever present – Brexit, US weather patterns, WTI, Greece ......
- Yield enhancement and factor investing have become more prevalent in recent years.
- The requirement to purchase tail risk protection has faded in recent years.
- Central Banks have placed a floor under assets via asset purchases and feedback loop of monetary policy.



Source: Fulcrum Asset Management LLP.

Conclusion

- Asymmetry of returns is fundamental to the risk premium.
- S&P 500 VRP has delivered long term robust returns.
- A move to a multi asset VRP results in significantly enhanced risk return profile.
- Periods of flat / adverse performance are to be expected from a risk premium extraction strategy.



	Multi Asset VRP
Annualised Return	7.6%
Volatility	4.3%
Sharpe Ratio	1.8
Max Drawdown	-13.1%

Source: Fulcrum Asset Management LLP. Returns based on a monthly exposure of 65bp vega via Fulcrum's implementation methodology.

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