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Performance of idiosyncratic volatility strategies in commodity markets: delusion or reality?

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The link between idiosyncratic volatility and returns has received scant attention in commodity futures markets although the corresponding literature for equities is very prolific. This article attempts to fill the gap by utilising various pricing models as benchmarks to extract the idiosyncratic volatility signal. We find that the abnormal performance of active strategies that systematically exploit idiosyncratic volatility is an illusion created by the choice of an inappropriate benchmark that fails to account for backwardation and contango.

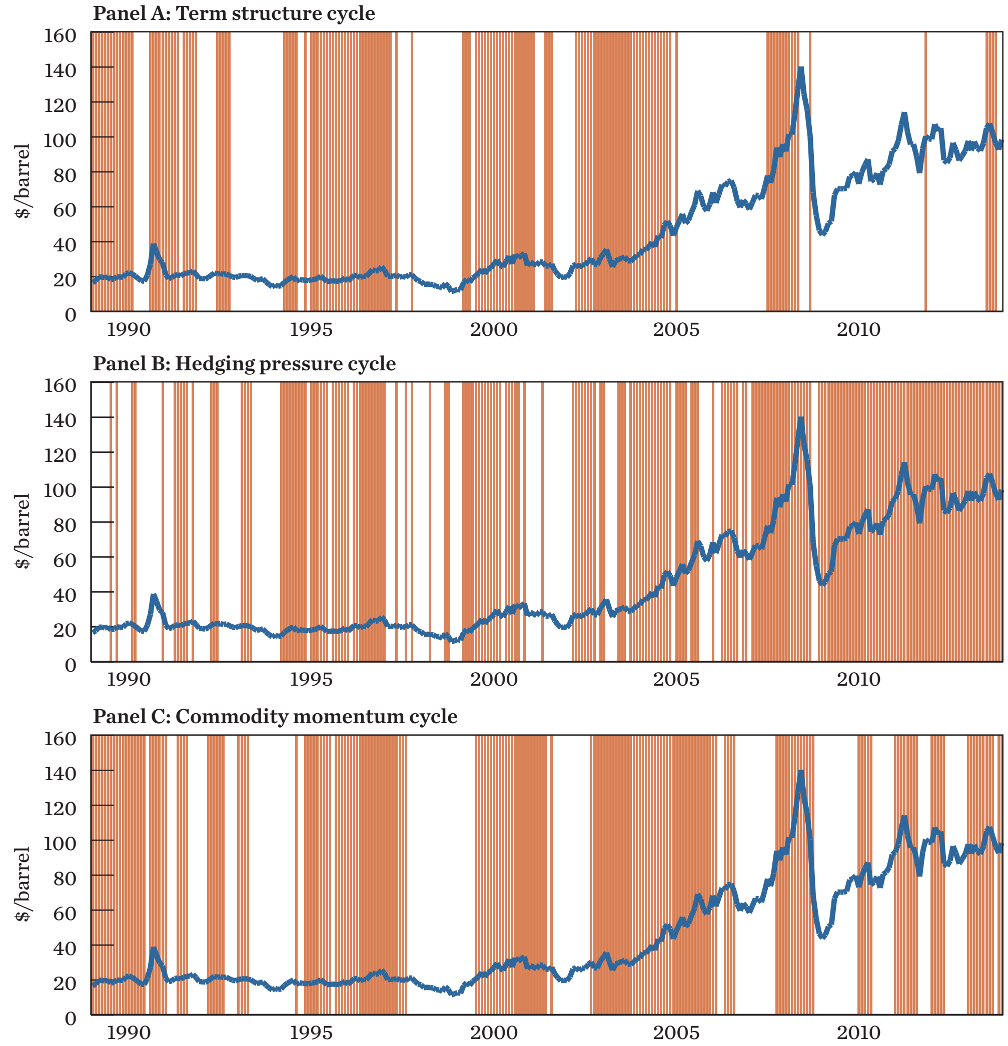
Defining the risk premium of commodity futures contracts

Idiosyncratic volatility of an asset is conventionally defined as the standard deviation of the estimated errors from a regression that describes the relationship between systematic risk and expected return. But which risk factors are plausible candidates in the context of commodities? We measure idiosyncratic volatility relative to two types of pricing models as benchmarks. Inspired by the traditional asset pricing literature, the first set of risk factors includes the S&P-GSCI, the US value-weighted equity index, the equity size (known as SMB) factor, equity value (HML) factor, equity momentum factor and Barclays bond index. The data are obtained either from Kenneth French's web library or from Bloomberg.

Motivated by the theory of storage (Kaldor [1939]; Fama and French [1987]) and the hedging pressure hypothesis (Cootner [1960]), the second set of risk factors is designed to capture commodity fundamentals relating to backwardation and contango. Backwardation means that futures prices are expected to rise as maturity approaches. It is signalled by downward-sloping term structures (positive roll-yields), net short hedgers, net long speculators and good past performance (backwardated commodities are momentum winners).[1] The concept is illustrated in figure 1, which plots the evolution in front-end crude oil futures prices. Shaded areas signify months with downward-sloping futures curves in panel A, months with net long speculators in panel B and months with positive 12-month past average returns in panel C. The three panels visually confirm that futures prices tend to rise in backwardated markets.

Our next task is to construct long-short commodity risk factors that capture the fundamentals of backwardation and contango. Using a cross-section of 27 commodity futures[2], the term structure portfolio buys the 20% of contracts with the most downward-sloping term structures and shorts the 20% of contracts with the most upward-sloping term structures. The hedging pressure portfolio buys the 20% of contracts for which hedgers are the shortest and speculators the longest and sells the 20% of contracts for which hedgers are the longest and speculators the shortest. Finally, the momentum portfolio buys the 20% of contracts with the best past performance and sells the 20% of contracts with the worst past performance.

1. Historical crude oil futures prices



The figure plots monthly futures prices of crude oil alongside shaded areas which indicate backwardated months when the monthly average of daily roll-yields is positive (panel A), when speculators are net long at the beginning and end of month (panel B) and when 12-month past returns are positive (panel C).

1 Vice versa, contango means that futures prices are expected to drop. It is hinted by upward-sloping term structures (or negative roll-yields), net long hedgers, net short speculators, and poor past performance (losers).

2 We use 12 agricultural commodities (cocoa, coffee C, corn, cotton no 2, frozen concentrated orange juice, oats, rough rice, soybean meal, soybean oil, soybeans, sugar no 11, wheat), five energy commodities (electricity, gasoline, heating oil no 2, light sweet crude oil, natural gas), four livestock commodities (feeder cattle, frozen pork bellies, lean hogs, live cattle), five metal commodities (copper, gold, palladium, platinum, silver), and random length lumber. The futures returns are constructed by holding the nearest-to-maturity contract up to one month before maturity and then rolling to the second nearest contract which lessens illiquidity.

The ranking period over which the three signals are averaged is 12 months, and the holding period is one month. The constituents of the long-short portfolios are equally weighted with end-of-month rebalancing and the portfolios are fully collateralised. The dataset spans the period from January 1989 to December 2013; the frequency of the data is daily.

Figure 2 summarises the performance of the various risk factors. Panel A focuses on the factors originating from the traditional asset pricing literature and panel B on the long-short commodity risk factors. The Sharpe ratios of the long-short commodity portfolios range from 0.41 to 0.51 with an average at 0.46, whereas that of the S&P-GSCI merely stands at 0.02. This reinforces the well-documented fact that investors benefit from taking long positions in backwardated markets and short positions in contangoed markets.

2. Summary statistics for risk factors

	Mean		Standard deviation	Sharpe ratio
Panel A: Traditional risk factors				
S&P-GSCI	0.0042	(0.10)	0.2122	0.0198
Equity market	0.0754	(2.07)	0.1783	0.4228
Barclays bond index	0.0373	(4.69)	0.0389	0.9597
Size (SMB)	0.0110	(0.60)	0.0894	0.1229
Value (HML)	0.0283	(1.52)	0.0908	0.3117
Equity momentum	0.0836	(3.02)	0.1353	0.6179
Panel B: Long-short commodity risk factors				
Term structure	0.0418	(2.02)	0.1009	0.4140
Hedging pressure	0.0448	(2.29)	0.0955	0.4694
Commodity momentum	0.0601	(2.48)	0.1186	0.5069

The table presents in panel A summary statistics for long-only traditional risk factors. Panel B presents summary statistics for long-short commodity risk factors based on term structure, hedging pressure and momentum signals. The observations are daily returns from 3 January 1989–31 December 2013. Conventional significance t-ratios are reported in parentheses. Sharpe ratios are annualised mean excess returns (Mean) divided by annualised standard deviations.

Performance of idiosyncratic volatility strategies

Our methodology follows closely Ang et al (2009) in their analysis of the relation between idiosyncratic volatility (*IVol* hereafter) and future equity returns. At the time of portfolio formation, we measure the idiosyncratic volatility of each commodity as the standard deviation of the estimated errors (or residuals) from the following empirical pricing model

$$r_{i,d} = \alpha_i + \beta_i f_d + \varepsilon_{i,d} \qquad d = 1, \ldots, D$$

where D is the number of days in the time window (ranking period R) spanning one, three, six or 12 months, $r_{i,d}$ is the day d return of the i^{th} commodity futures, f_d is a vector of factor returns associated with the chosen benchmark on day d, $\varepsilon_{i,d}$ is an innovation and $\{\alpha_i,\beta_i\}$ are OLS parameters. For a given benchmark, the *IVol* strategy buys the quintile of commodities with the lowest *IVol* over the past R (= 1, 3, 6 or 12) months, sells the quintile with the highest *IVol* and holds the long-short portfolio for a month. For consistency with the construction of the long-short commodity risk factors, the long-short *IVol* portfolios are fully collateralised, rebalanced at the end of each month and based on equal weights for the constituents of the top and bottom quintiles. Figure 3 summarises the performance of *IVol* strategies designed upon traditional benchmarks (panel A) and benchmarks based on long-short commodity risk factors (panel B). Panel C reports summary statistics for an equally-weighted portfolio of the 16 *IVol* portfolios of panel A and the 16 *IVol* portfolios of panel B.

An equally-weighted portfolio of the 16 *IVol* strategies built upon the traditional benchmarks earns 3.93% a year, significant at the 5% level; 14 of these 16 strategies generate significantly positive mean excess returns at the 10% level or better (panel A). In sharp contrast, an equally-weighted portfolio of the 16 *IVol* strategies built upon benchmarks with long-short commodity risk factors earns an economically and statistically insignificant 1.22% a year; none of these 16 strategies generate significantly positive mean excess returns at the 10% level (Panel B). Likewise, the Sharpe ratios are more optimistic for *IVol* strategies based on traditional risk factors (averaging 0.37 in Panel A) than for *IVol* strategies based on long-short commodity risk factors (averaging 0.12 in Panel B). The t-test for the difference in Sharpe ratios developed by Opdyke (2007) confirms, with a statistic equal of 1.74 in the present context, the contrast between the two types of *IVol* strategies.

The alpha or abnormal return captured ►

3. Summary performance of idiosyncratic volatility mimicking portfolios

	Mean		Standard deviation	Sharpe ratio	Alpha		Mean		Standard deviation	Sharpe ratio	Alpha	
	Panel A: Traditional risk factors						Panel B: Fundamental (long-short commodity) risk factors					
	S&P-GSCI						Term structure					
R = 1	0.0432	(1.99)	0.1062	0.4069	0.0429	(2.01)	0.0258	(1.13)	0.1108	0.2325	0.0259	(1.12)
R = 3	0.0388	(1.80)	0.1053	0.3684	0.0385	(1.78)	0.0093	(0.42)	0.1095	0.0851	0.0087	(0.38)
R = 6	0.0365	(1.68)	0.1057	0.3453	0.0361	(1.67)	0.0054	(0.24)	0.1073	0.0499	0.0051	(0.23)
R = 12	0.0440	(2.02)	0.1064	0.4133	0.0435	(2.05)	0.0048	(0.22)	0.1065	0.0447	0.0052	(0.24)
Average	0.0406		0.1059	0.3835	0.0402		0.0113		0.1085	0.1031	0.0112	
	S&P-GSCI, equity and bond indices						Hedging pressure					
R = 1	0.0404	(1.87)	0.1057	0.3823	0.0372	(1.76)	0.0270	(1.22)	0.1078	0.2503	0.0202	(0.92)
R = 3	0.0369	(1.70)	0.1057	0.3495	0.0344	(1.58)	0.0089	(0.39)	0.1119	0.0798	0.0006	(0.03)
R = 6	0.0420	(1.92)	0.1059	0.3965	0.0413	(1.90)	0.0182	(0.80)	0.1106	0.1642	0.0104	(0.46)
R = 12	0.0398	(1.78)	0.1069	0.3722	0.0395	(1.81)	0.0075	(0.33)	0.1109	0.0679	-0.0007	(-0.03)
Average	0.0398		0.1060	0.3751	0.0381		0.0154		0.1103	0.1405	0.0076	
	S&P-GSCI, equity and bond indices, SMB and HML						Commodity momentum					
R = 1	0.0425	(1.96)	0.1057	0.4021	0.0402	(1.86)	0.0131	(0.62)	0.1028	0.1271	0.0159	(0.76)
R = 3	0.0404	(1.87)	0.1054	0.3838	0.0389	(1.79)	0.0038	(0.17)	0.1060	0.0356	0.0065	(0.29)
R = 6	0.0405	(1.84)	0.1064	0.3803	0.0405	(1.84)	0.0012	(0.06)	0.1040	0.0115	0.0051	(0.23)
R = 12	0.0399	(1.79)	0.1071	0.3731	0.0403	(1.84)	-0.0013	(-0.06)	0.1014	-0.0130	0.0007	(0.03)
Average	0.0408		0.1062	0.3848	0.0400		0.0042		0.1036	0.0403	0.0070	
	S&P-GSCI, equity and bond indices, SMB and HML, equity momentum						Term structure, hedging pressure and commodity momentum					
R = 1	0.0278	(1.29)	0.1053	0.2640	0.0258	(1.21)	0.0226	(1.13)	0.0977	0.2309	0.0196	(0.98)
R = 3	0.0358	(1.64)	0.1062	0.3372	0.0358	(1.64)	0.0202	(0.99)	0.0991	0.2036	0.0165	(0.80)
R = 6	0.0400	(1.82)	0.1066	0.3754	0.0412	(1.86)	0.0172	(0.84)	0.0998	0.1719	0.0139	(0.65)
R = 12	0.0395	(1.77)	0.1071	0.3689	0.0417	(1.90)	0.0117	(0.56)	0.1017	0.1150	0.0063	(0.30)
Average	0.0358		0.1063	0.3364	0.0362		0.0179		0.0996	0.1803	0.0141	
	Panel C: Comparison of average performance across benchmarks											
	0.0393	(2.00)	0.1061	0.3699	0.0386		0.0122	(0.64)	0.1055	0.1161	0.0100	
							(1.13)			(1.74)	(12.80)	

The table reports annualised mean excess return (Mean), standard deviation, Sharpe ratio and alpha of long-short idiosyncratic volatility portfolios. R stands for the ranking period used to measure idiosyncratic volatility. The holding period is one month throughout. t-statistics are shown in parentheses. Idiosyncratic volatility is defined, and performance is gauged, according to traditional risk factors in Panel A and long-short commodity risk factors in Panel B. In the last row of Panel C we report in parentheses the ordinary t-test for differences in mean return, the Opdyke (2007) t-test statistic for the significance of differences in the Sharpe ratio and the ordinary t-test for differences in alpha performance of the equally-weighted idiosyncratic volatility portfolios reported in Panel A versus Panel B.

by the intercept parameter (in a regression of daily *IVol* returns on the systematic risk factors) also suggests that *IVol* strategies based on traditional risk factors are over-optimistic relative to those based on long-short commodity risk factors. The former strategies (reported in panel A of figure 3) deliver an alpha of 3.86% a year on average while the alpha of the latter strategies is much smaller at 1% (panel B); the difference is statistically significant at the 1% level (t-statistic of 12.80 in panel C). The Newey and West (1987) t-test confirms that the alpha of *IVol* strategies designed upon traditional benchmarks is positive and generally significant at the 10% level or better whereas the alpha of *IVol* strategies based on long-short commodity risk factors is insignificant.

Conclusions

This article investigates the relation between idiosyncratic volatility and expected returns in commodity futures markets. The main finding is that the significantly abnormal performance of *IVol* portfolios in commodity futures markets is an 'illusion' of the asset pricing model employed as benchmark to extract the *IVol* signal. We show that when traditional benchmarks are used the commodity futures *IVol* portfolios appear to perform remarkably well as suggested by an annualised mean excess return, Sharpe ratio and alpha of 3.93%, 0.37 and 3.86% on average, respectively. When the benchmarks are based on long-short commodity risk factors that exploit term structure, hedging pressure or momentum signals (and thus capture the fundamentals of backwardation and contango) the mean excess return, Sharpe ratio and alpha shrink to 1.22%, 0.12 and 1% a year on average, respectively.

The seemingly abnormal profits made by selling commodities with high idiosyncratic volatility and buying commodities with low idiosyncratic volatility is an artifact of two methodological issues pertaining to the choice of asset pricing model. One is that the idiosyncratic volatility signal derived from traditional benchmarks is not idiosyncratic because it contains a systematic risk component related to the backwardation and contango fundamentals. Another is that the alpha is gauged using an improper benchmark.

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Improving traditional risk parity strategies by considering more appropriate risk measures than historical volatility

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Since 2008, risk parity has become a popular approach to building well-diversified portfolios that does not rely on any assumption of expected returns, thus placing risk management at the heart of the portfolio construction process. This explains why an increasing number of pension funds and other institutional investors are now using this approach both within asset classes, and notably for the development of smart beta equity and bond benchmarks[1], and across asset classes – ie, for the redefinition of their long-term investment policy portfolios[2].

In a nutshell, the goal of this methodology is to ensure that the risk contributions will be identical for all constituent assets of the portfolio. This heuristic approach stands in contrast with the more traditional approach to naive diversification, the equally-weighted portfolio, which is by construction well balanced in terms of dollar contributions, but concentrated in terms of risk contributions. This risk budgeting approach method is also different from scientific approaches to portfolio diversification, including mean-variance optimisation and its variants, such as the Black-Litterman model, which incorporates parameter uncertainty. One key advantage of risk budgeting is that it is much less sensitive to errors in input parameters and does not produce corner solutions that are typical outcomes of portfolio optimisation programmes.

These desirable properties and the attractive performance of such strategies in recent years undoubtedly explain the success of risk parity diversified funds based on equities, bonds and commodities. For instance, Invesco manages about $22bn (€16.6bn) using a risk parity strategy[3]. Another commercial success is Bridgewater's All Weather Fund, which is one of the largest hedge funds in the world.

However, risk parity strategies also suffer from a number of shortcomings:

- Standard approaches to risk parity are based on portfolio volatility as the risk measure, implying that upside risk is penalised as much as downside risk, in obvious contradiction with investors' preferences.
- Typical risk parity strategies inevitably involve a substantial overweighting of bonds with respect to equities, which might be a problem in a low bond yield environment, with mean reversion implying that a drop in long-term bond prices might be more likely than a further increase in bond prices. More generally, risk parity strategies do not take into account changing economic environments and in particular time-varying risk premia.

Perhaps as a consequence of these shortcomings, the performance of risk parity funds was disappointing overall in 2013. Indeed, most of them posted negative or flat performances in a context of strong equity returns. Moreover, dispersion among their performances was high, with as much as a 20% difference between the best and worst performers.

1 Asset managers and index providers have launched several risk parity products and indices on equities, for example FTSE, LODH, Lyxor, FTSE, ERI Scientific Beta, and also on bonds, for example, Aquila Capital and Lyxor.
2 See, for instance, the special report on risk parity published by IPE in June 2012 and the interview with Henrik Gade Jepsen, CIO of Danish pension fund ATP.
3 Source: Invesco Balanced-Risk Allocation Fund Fourth Quarter 2013.

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