

**EDHEC Alternative
Investment Days
2007**

Bringing Academic Insights to
Alternative Investment

**16:00-17:30
Stream 3H:
State-of-the-Art Commodities Investing**

Chairman:

Geoff Reader, Head of Pensions and Treasury Department, Bedford County Council

Speaker:

Joëlle Miffre, Associate Professor, EDHEC Business School

Panellists:

Laurent Chevallier, Head of Manager Research & Investment, Hedge Funds, Unigestion

Ralf Huesmann, Eurex Product Design, Product Manager, Eurex

Vera Kupper Staub, Head of Asset Investment, City of Zurich Pension Fund

Carolyn White, Senior Investment Manager for Alternatives, West Midlands Pension Fund

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State-of-the-Art Commodities Investing

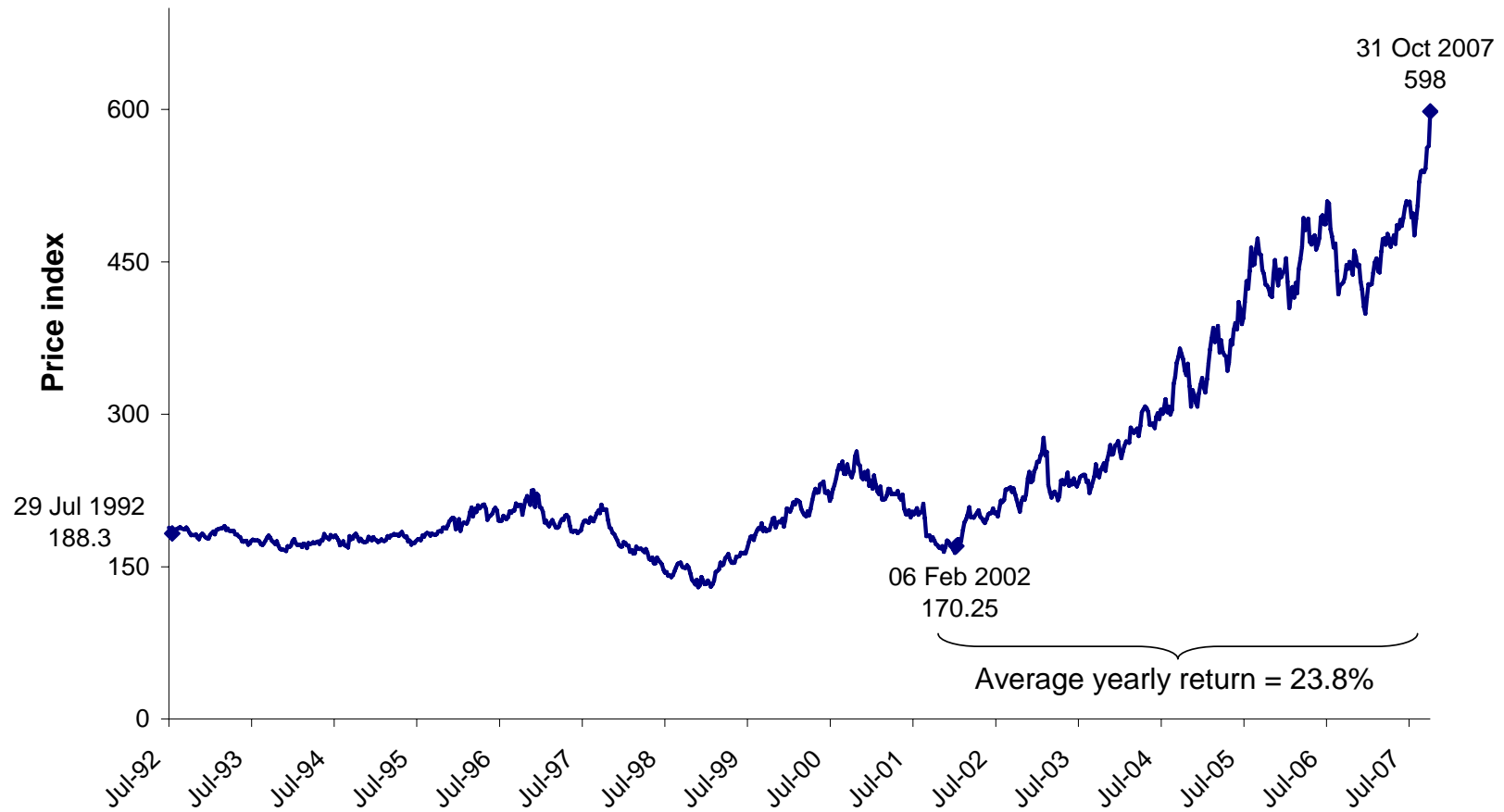
Joëlle Miffre

Associate Professor, EDHEC Business School

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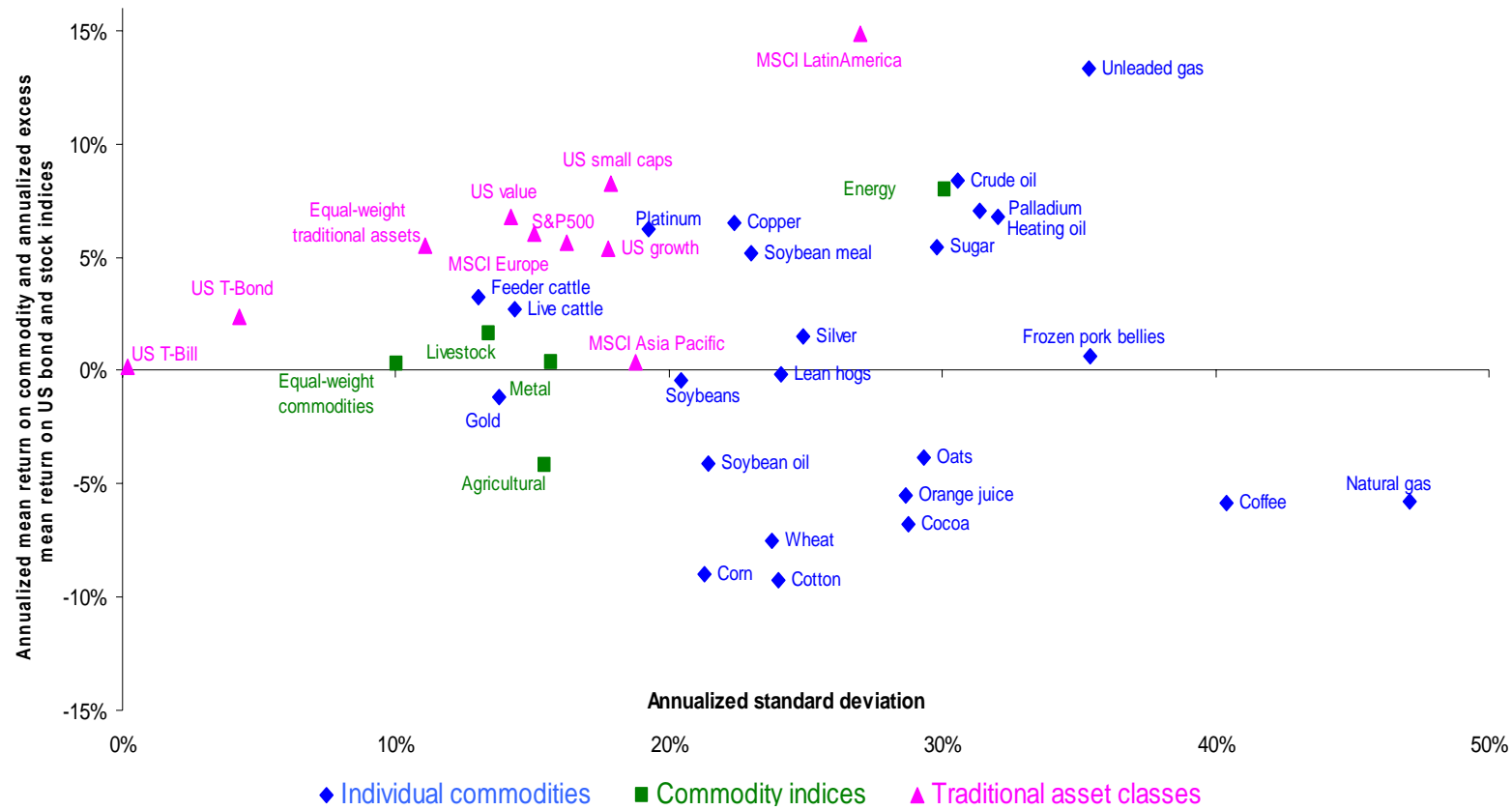
Goldman Sachs Commodity Index



State-of-the-Art Commodities Investing

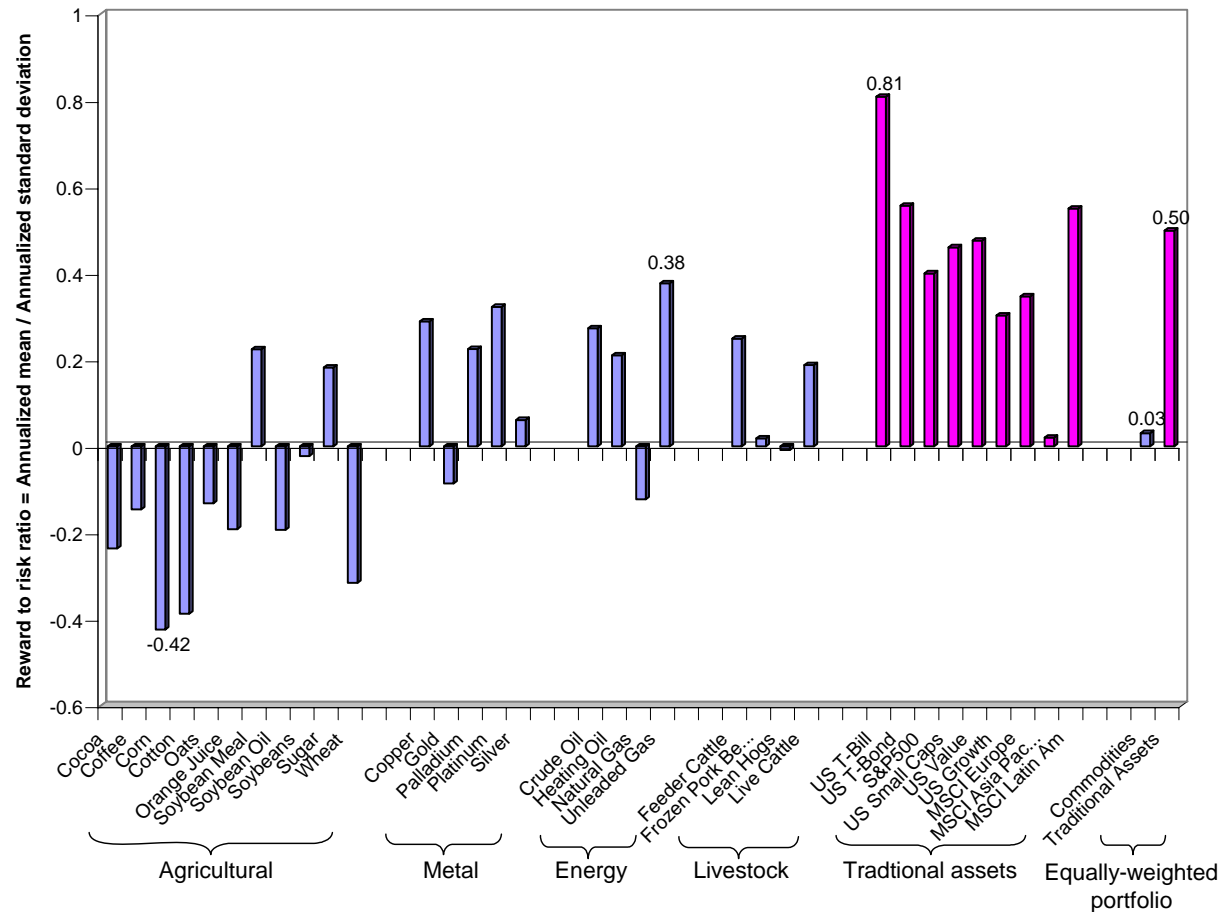
- Using commodities for strategic asset allocation
 - Risk-return relationship
 - Higher moment properties
 - Inflation hedge
 - Portfolio diversifiers and conditional correlations
- Using commodities for tactical asset allocation
 - Term structure strategy
 - Momentum strategy
 - Economic-based strategy

Poor performance on a stand-alone basis

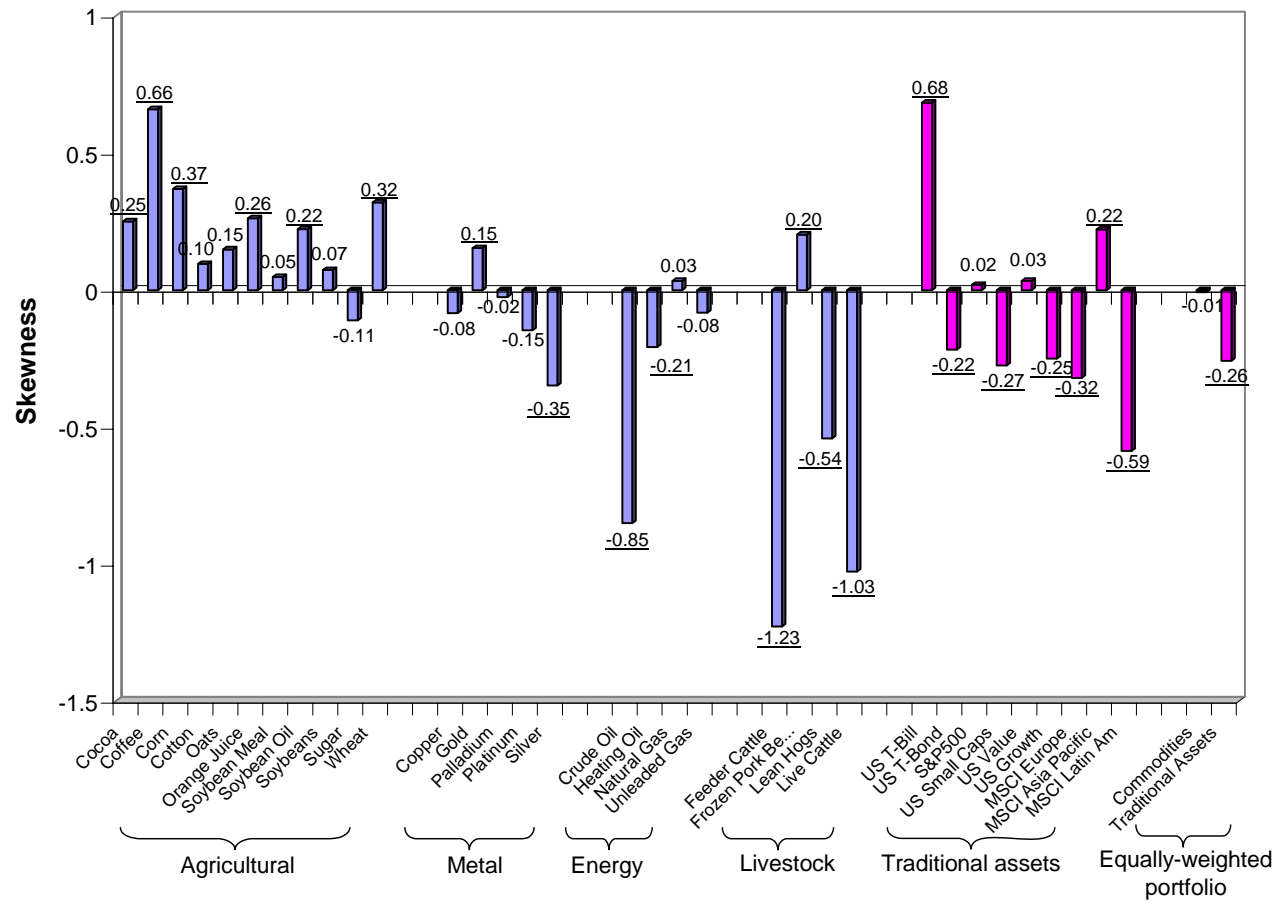


Sample = Oct 1990 – Dec 2006

Poor performance on a stand-alone basis: Reward to risk ratios

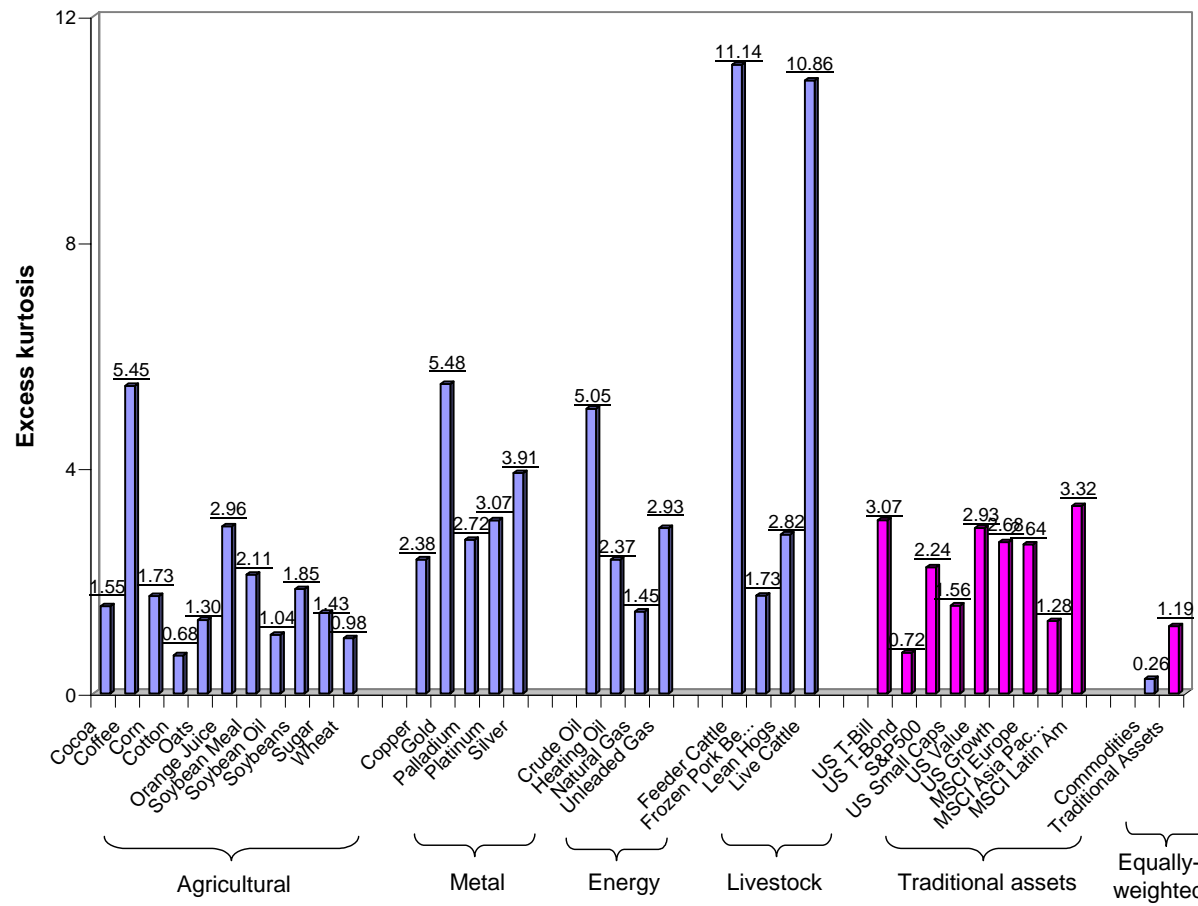


Higher moments properties: Average skewness slightly higher than that of stocks and bonds



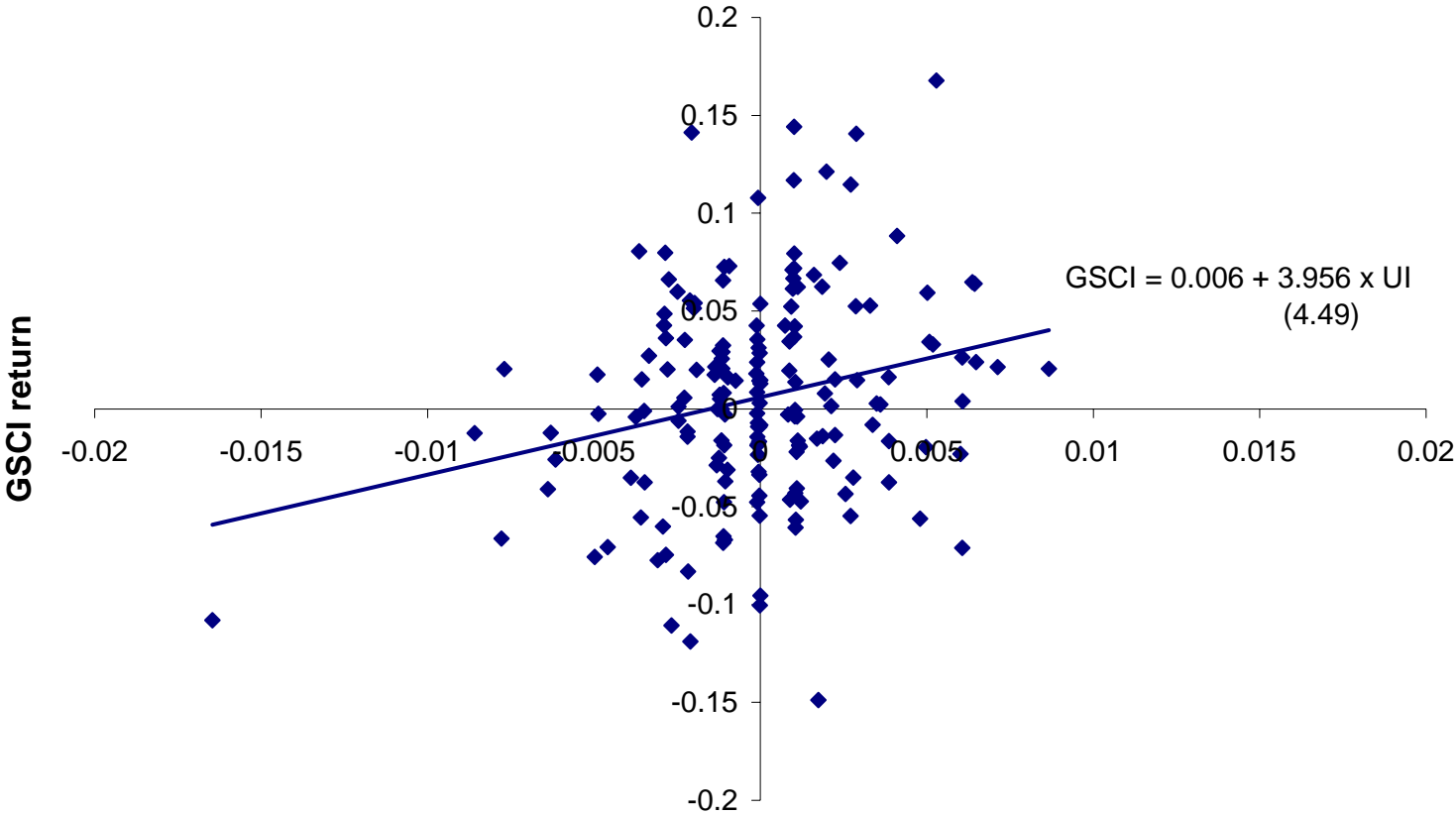
Underlined = Significant at 5%

Higher moments properties: Average excess kurtosis slightly lower than that of stocks and bonds



Underlined = Significant at 1%

GSCI is a good hedge against unexpected inflation



Unexpected inflation = Year-on-year change in inflation

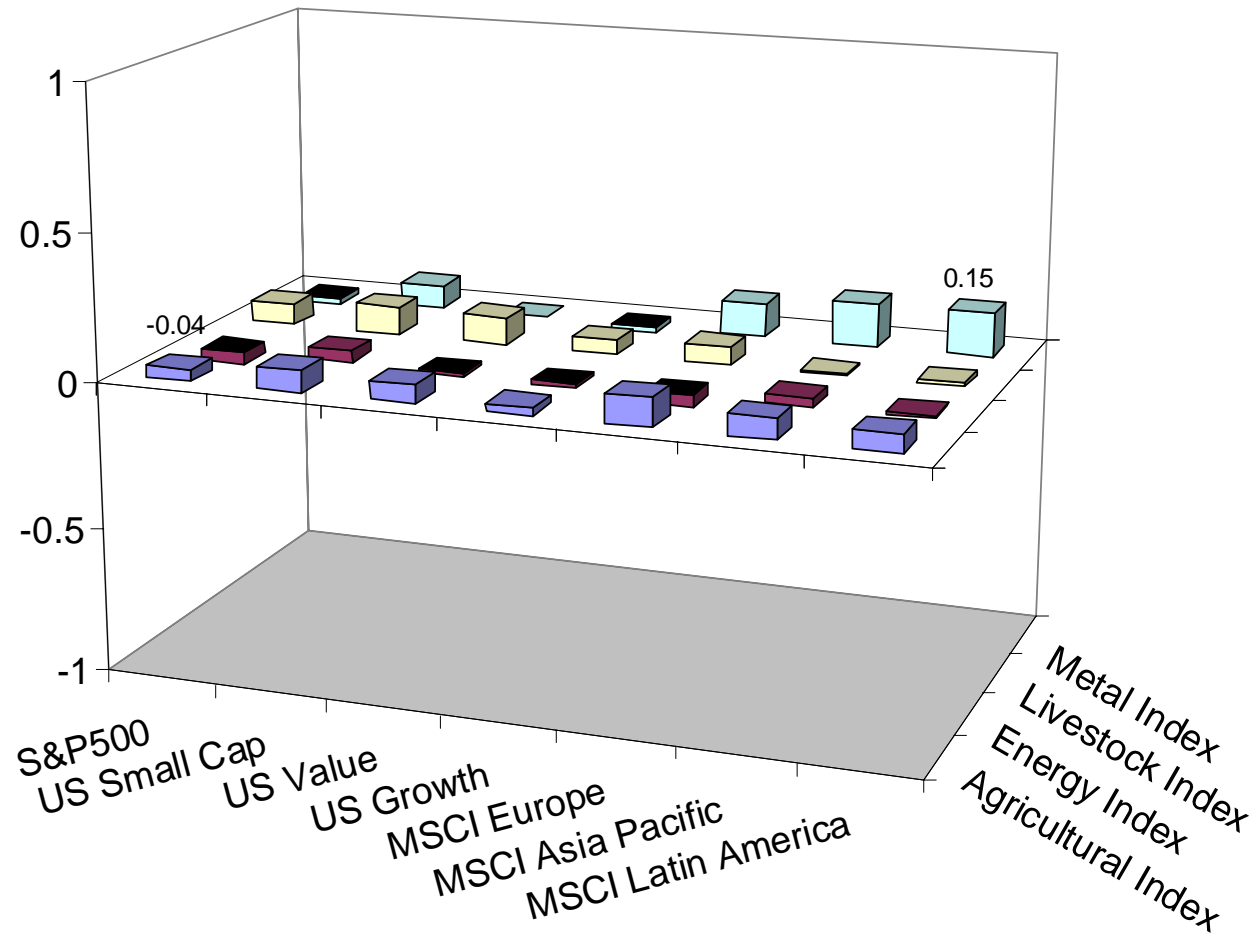
Correlation between GSCI returns and unexpected inflation = 0.24

But not all commodities serve as a good hedge against unexpected inflation

	β_{UI}	$t(\beta_{UI})$		β_{UI}	$t(\beta_{UI})$
Agricultural Commodities			Livestock Commodities		
Cocoa	-1.1019	-0.60	Feeder Cattle	0.6892	0.90
Coffee	0.3746	0.17	Frozen Pork Bellies	3.5978	1.56
Corn	-3.3616	-2.00	Lean Hogs	2.2896	1.54
Cotton	2.0484	2.10	Live Cattle	1.1314	1.52
Oats	-5.8793	-2.55	Livestock Index	1.4517	1.83
Orange Juice	-1.8562	-0.97			
Soybean Meal	-3.5413	-2.10	Metal Commodities		
Soybean Oil	-0.3268	-0.22	Copper	0.2362	0.30
Soybeans	-2.3997	-1.60	Gold	1.5682	1.74
Sugar	2.4236	1.27	Palladium	4.0148	1.82
Wheat	-1.6003	-0.98	Platinum	3.7072	3.21
Agricultural Index	-2.1554	-2.02	Silver	0.4613	0.35
			Metal Index	1.3044	1.43
Energy Commodities					
Crude Oil	5.9046	4.02	GSCI	3.9563	4.49
Heating Oil	4.4438	2.34			
Natural Gas	6.3224	1.71			
Unleaded Gas	9.1185	5.40			
Energy Index	5.9368	4.39			

Energy, livestock and metal are better hedges against
unexpected inflation than agricultural commodities

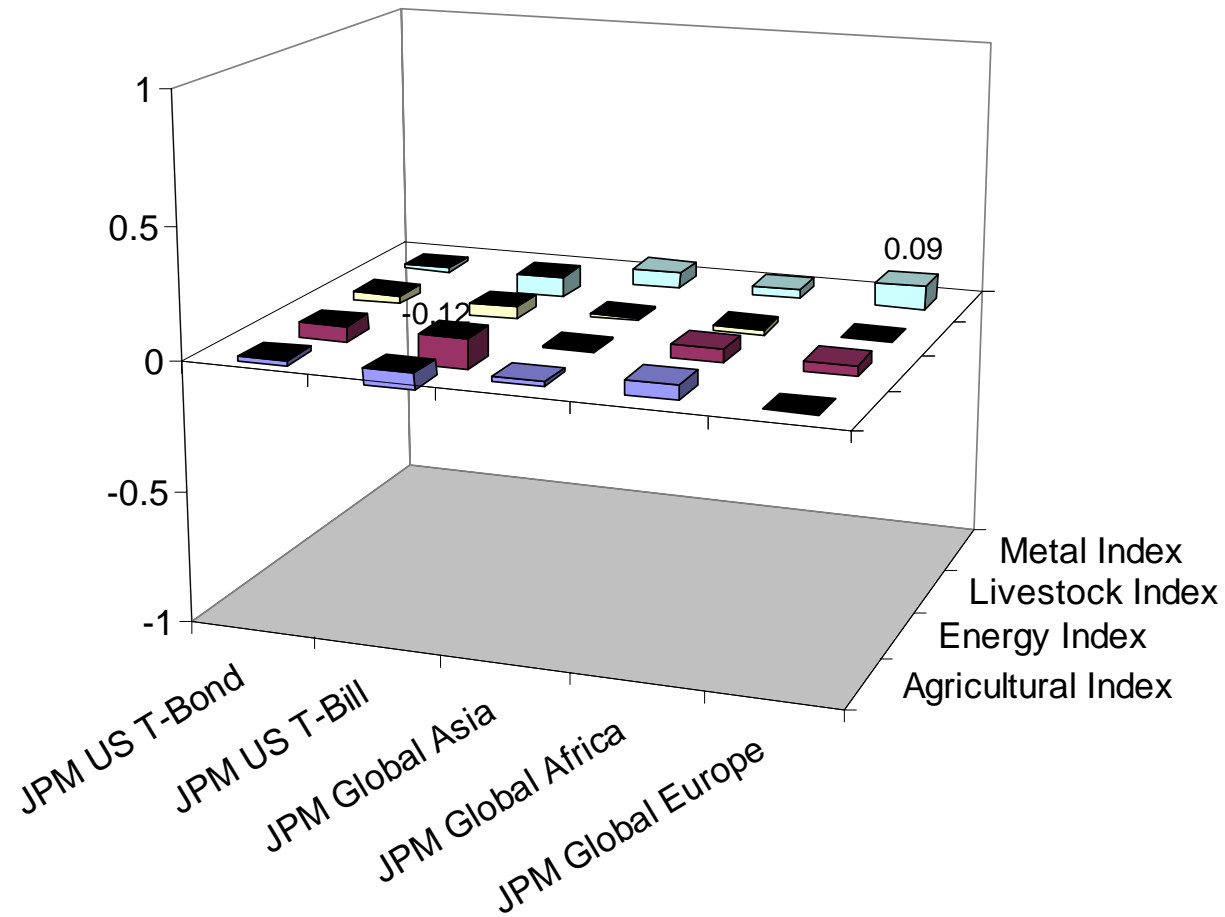
Commodities have low correlations with US and global equity indices



Average = 0.04

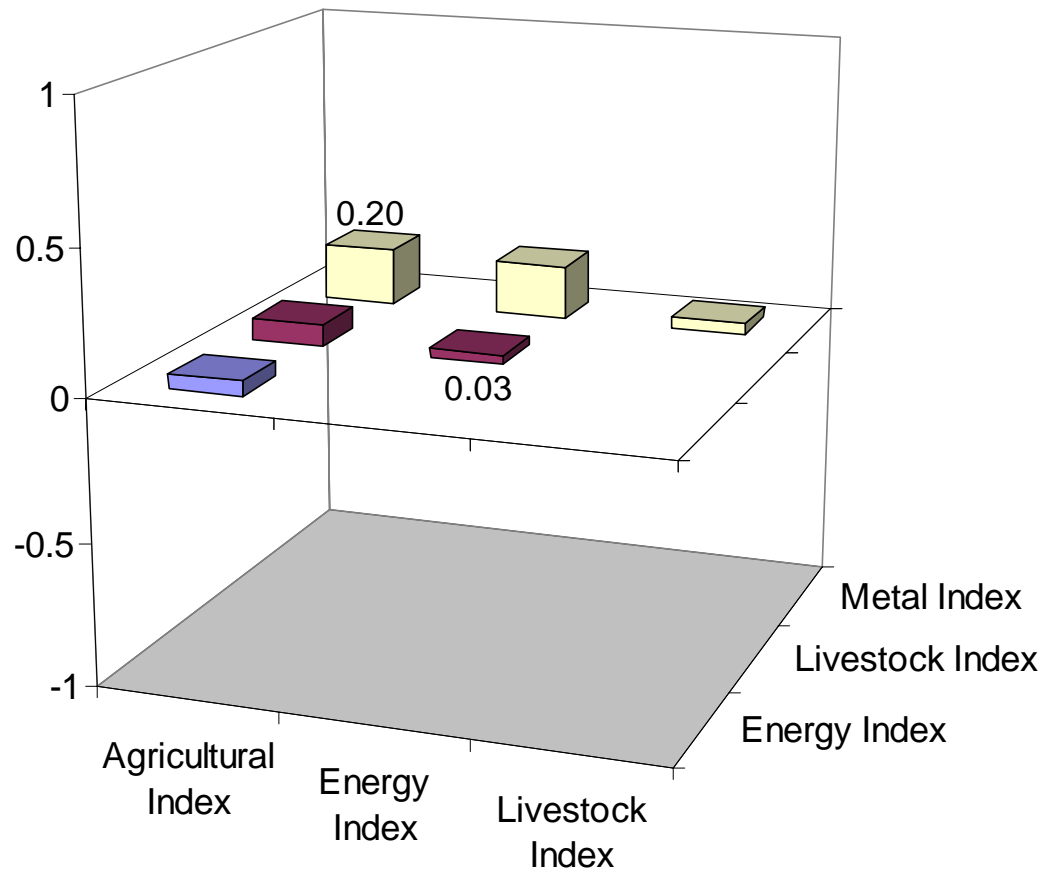
Sample = Oct 1990 – Dec 2006

Even lower correlations with J.P. Morgan US and global fixed income indices



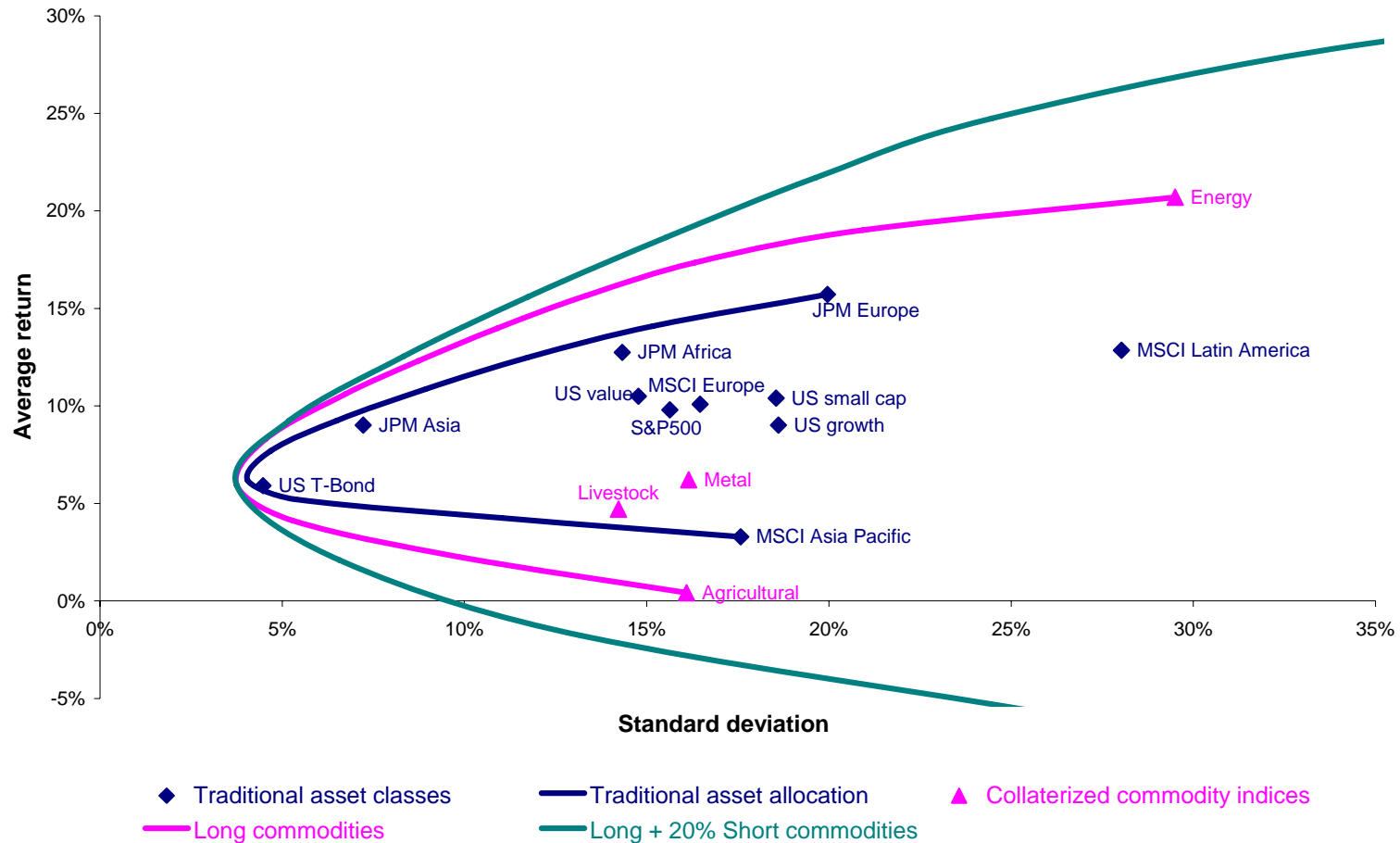
Average = -0.01

Low correlations with one another



Average = 0.10

And thus useful diversifiers for strategic asset allocation

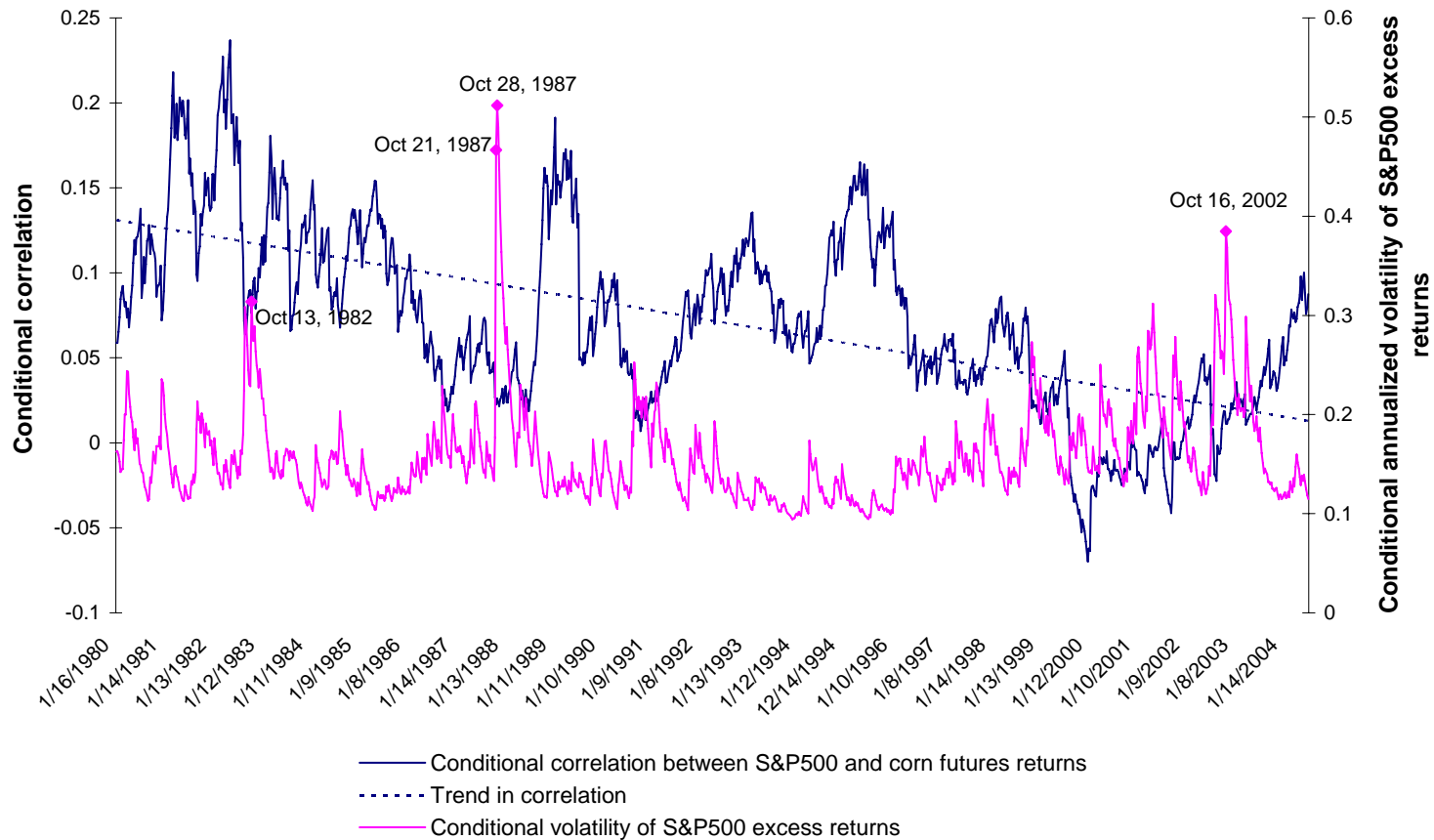


Sample = Oct 1990 – Dec 2006

What about the conditional correlations?

- Research thus far focused on the unconditional correlations between commodities and traditional asset classes
- Chong and Miffre (2006) use a bivariate GARCH(1,1) model to analyze how the conditional correlations between commodities and S&P500 returns evolve
 - over time
 - in periods of high market volatility

Unstable correlations over time: The case for corn and the S&P500 index



Correlation between conditional correlation and conditional S&P500 volatility = -46.35%

Conditional correlations with the S&P500 tend to decrease in periods of high volatility in equity markets

Regression of conditional correlations between commodity futures returns and S&P500 returns on the conditional volatility of the S&P500 index

The table reports the slope coefficients and associated t -statistics

	S&P500 Volatility			S&P500 Volatility	
	β	$t(\beta)$		β	$t(\beta)$
Agricultural Commodities			Livestock Commodities		
Cocoa	0.5414	18.55	Feeder Cattle	1.4763	5.25
Coffee	-1.2360	-20.85	Frozen Pork Bellies	-0.3292	-4.24
Corn	-3.4539	-13.84	Lean Hog	-0.8051	-2.40
Cotton	0.7182	1.54	Live Cattle	0.8381	5.69
Oats	-2.3895	-10.58			
Orange Juice	-1.9153	-12.11	Metal and Other Commodities		
Soybean Meal	-1.2531	-7.40	Gold	-4.2479	-9.09
Soybean Oil	-0.9168	-2.66	Heating Oil	-0.8999	-1.86
Soybeans	-2.3392	-7.89	Lumber	-1.5186	-6.57
Sugar	2.9632	7.67	Palladium	0.5799	1.98
Wheat	-1.7521	-12.08	Platinum	-0.3236	-0.90
			Silver	0.1777	0.96

Sample: Jan 1979 - May 2004

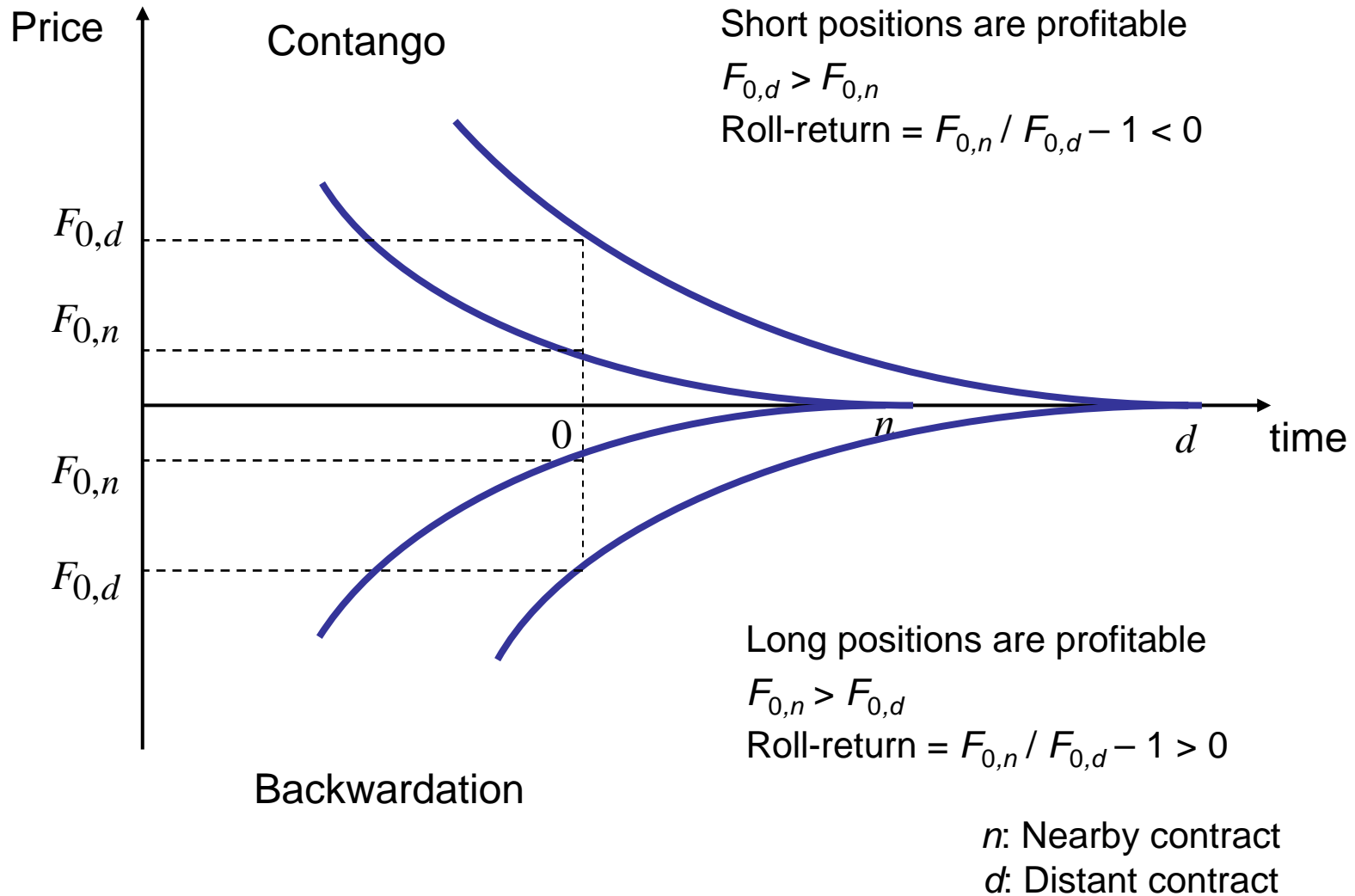
Unstable correlations over time

- Excellent tools for diversification: Correlations between commodities and S&P500 index fall over time and in periods of high volatility in equity markets
- This is fortunate: When the volatility in equity markets is high, the benefits of diversification are the most appreciated
- Explanation 1: Flight-to-quality hypothesis
 - Precious metals are refuge assets
 - Stop-loss selling strategies of equity investors
- Explanation 2: Different impacts of major events on commodity and stock returns
 - Oil shocks, Wars, Hurricane, Unexpected rise in inflation...
 - Positive (Negative) skewness in commodity (S&P500) returns

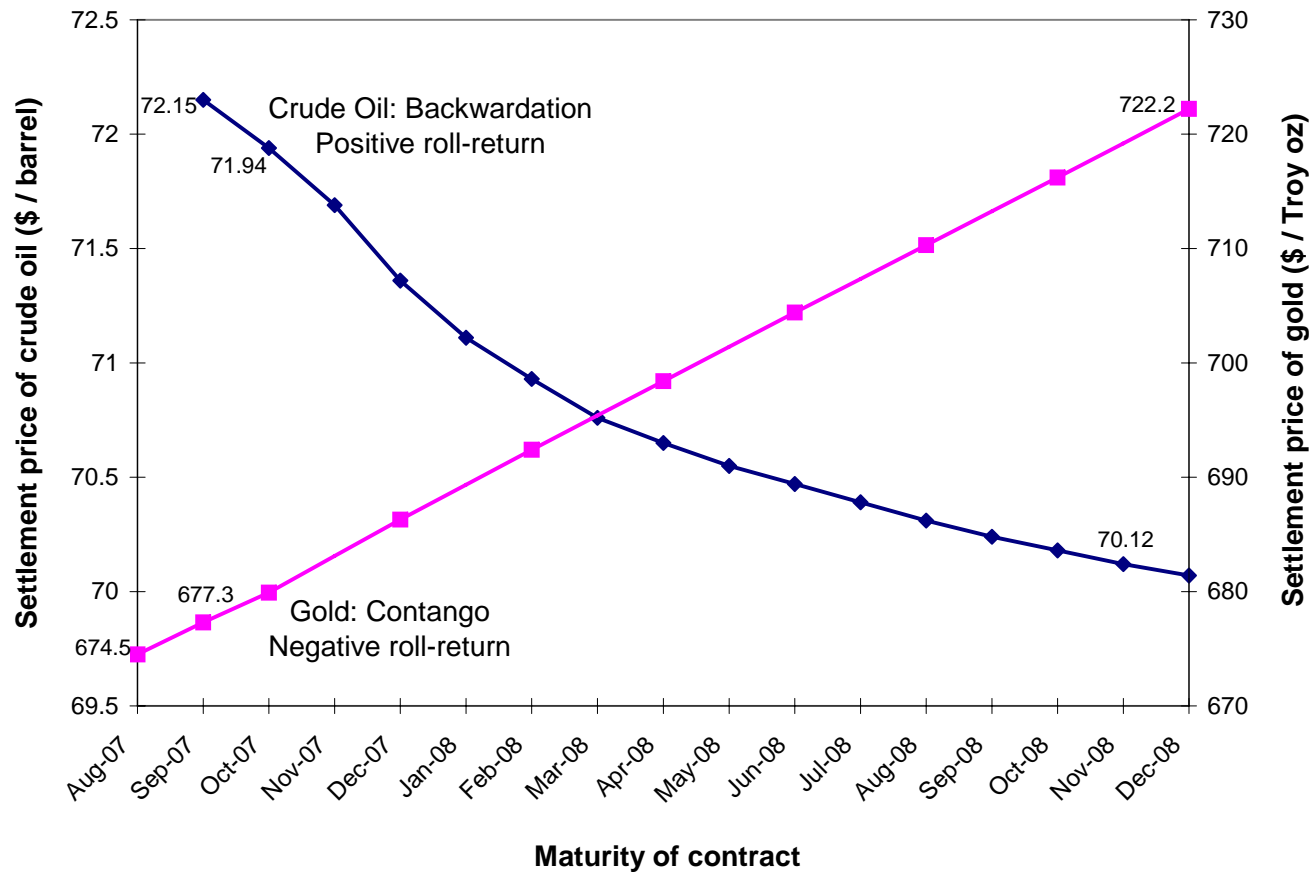
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Backwardation and contango



Term structure of crude oil and gold futures prices on Aug, 9 2007

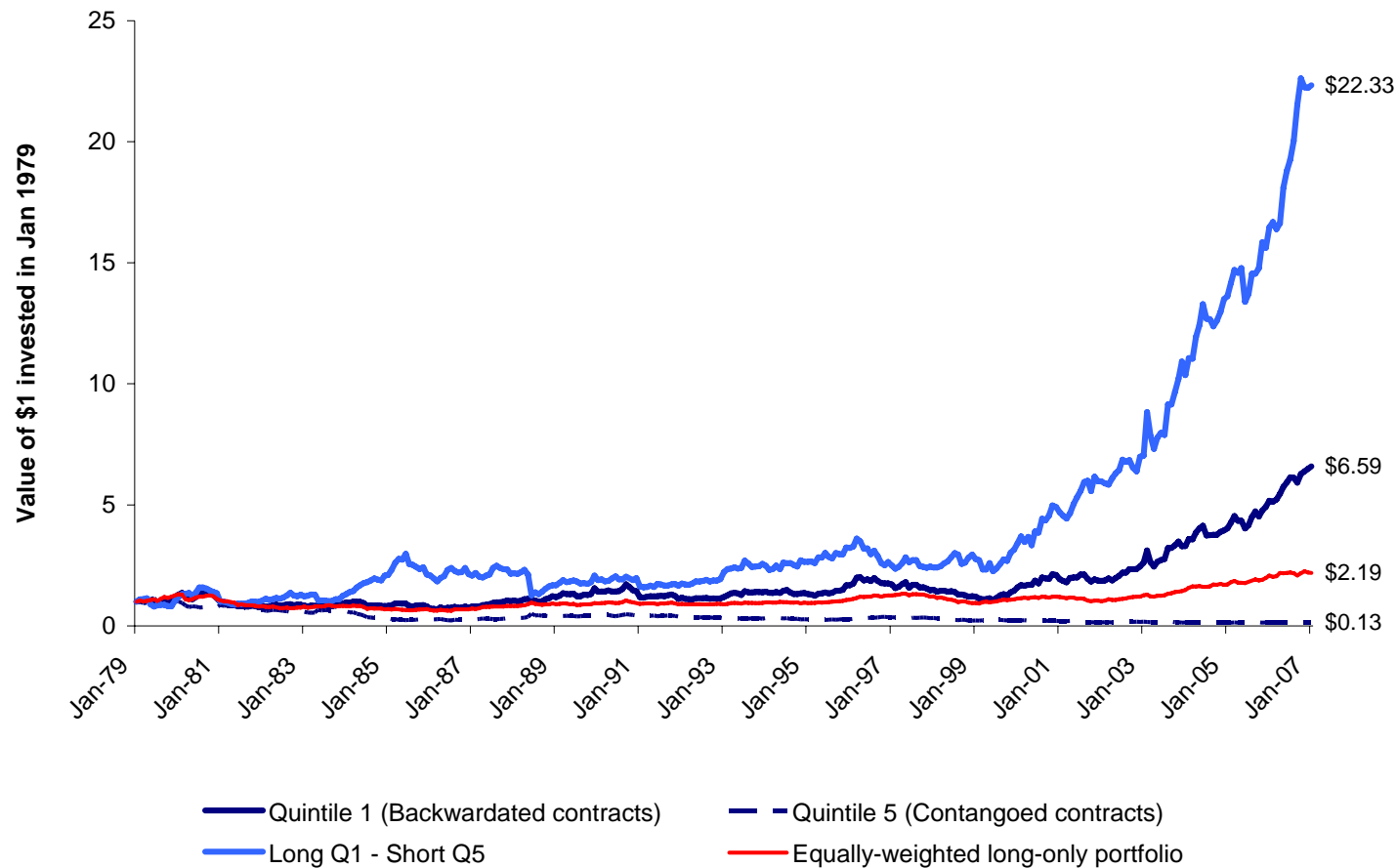


A backwardated market has a downward sloping term structure and positive roll-returns
A contangoed market has an upward sloping term structure and negative roll-returns

Term structure strategy

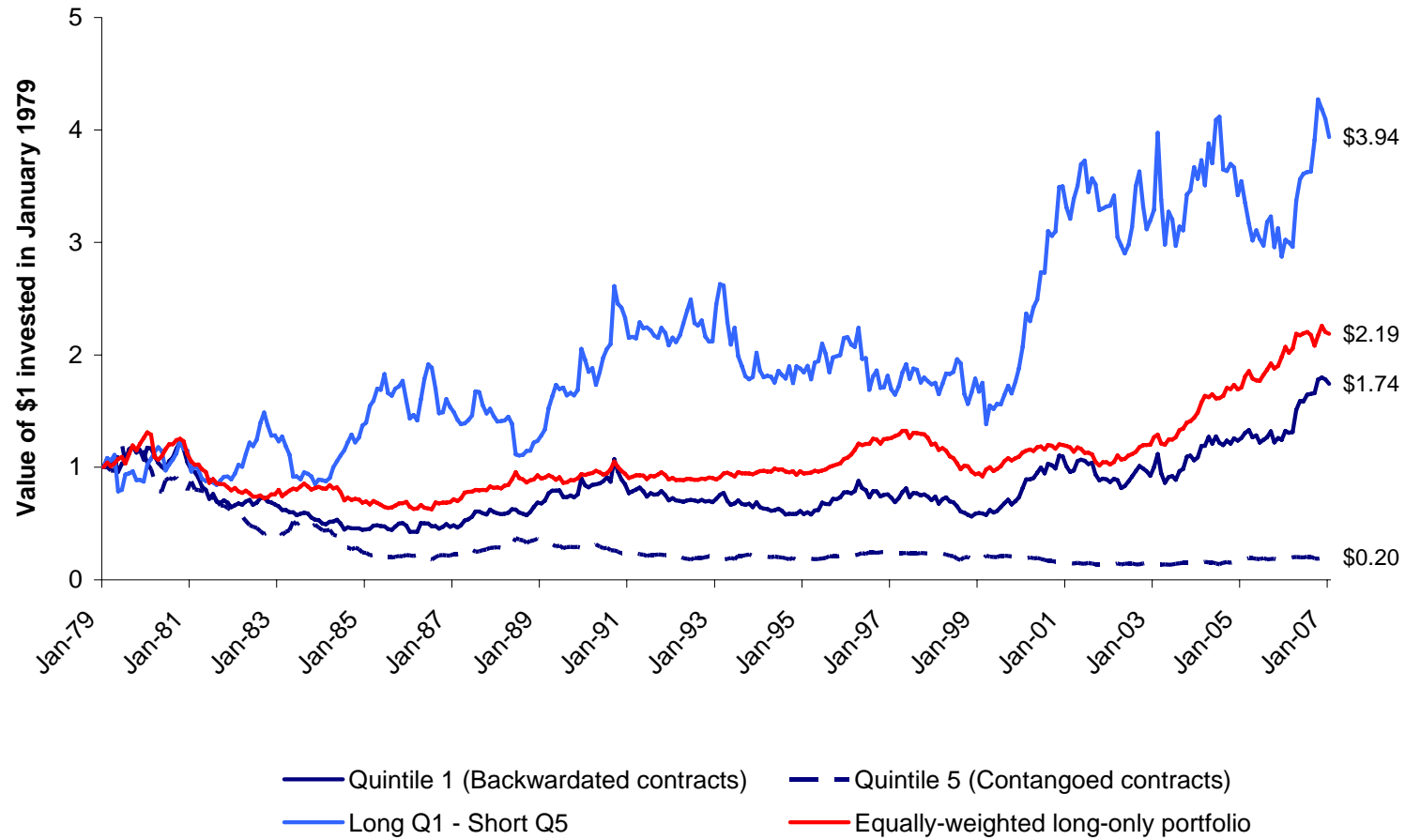
- Rallis, Fuertes and Miffre (2007)
- At the end of each month we measure the roll-returns of 37 commodities as $F_{0,n} / F_{0,d} - 1$
 - $F_{0,n}$ = Price of nearby contract (contract with the nearest maturity)
 - $F_{0,d}$ = Price of distant contract (contract with the second nearest maturity)
- Sort all commodities into quintiles based on their roll-returns
 - Q_1 = Quintile with the highest roll-returns (most backwardated contracts)
 - Q_5 = Quintile with the lowest roll-returns (most contangoed contracts)
- Go long Q_1 , short Q_5 and hold the position for a month
- Repeat the strategy over the sample Jan 1979 – Jan 2007
- Compare the performance of the active strategy to that of a long-only strategy

Future value of \$1 when the roll-returns are measured relative to the 2nd nearest contract



Source: Rallis, Fuertes and Miffre (2007)

What if the roll-returns are measured relative to the most distant contract?



Summary statistics of performance

	TS_1	TS_2	Index
Average monthly return	0.1410 *	0.0776 **	0.0340
Standard deviation	0.2384	0.2379	0.1092
Reward/Risk ratio	0.5912	0.3261	0.3111
Skewness	-0.6990 *	-0.1819	-0.5108 *
Excess kurtosis	5.1822 *	1.5657 *	1.7017 *
JB normality test	403.34 *	36.18 *	55.15 *
Best month	0.2805	0.2466	0.0944
Worse month	-0.4042	-0.2923	-0.1533
99% VaR	-0.2107	-0.1902	-0.0944
95% VaR	-0.0941	-0.1026	-0.0460

TS_1 : Roll-returns are measured relative to the 2nd nearest contract

TS_2 : Roll-returns are measured relative to the most distant contract

Index: Long-only equally-weighted portfolio of commodity futures

* and **: Significant at the 1% and 10% levels

Alphas and betas of term structure strategies

Regression of the monthly returns on the long/short strategies on

- a constant, used as a measure of abnormal performance (α)
- the excess returns on the S&P500 index ($\beta_{\text{S\&P500}}$)
- the excess total returns on Lehman Aggregate US Bond Index (β_{LB})
- the GSCI excess returns (β_{GSCI})

	TS_1	TS_2
α	0.0117 *	0.0056
Annualised α	0.1408	0.0666
$\beta_{\text{S\&P500}}$	-0.0895	-0.0764
β_{LB}	-0.1352	0.0567
β_{GSCI}	0.2257 **	0.3612 *

TS_1 : Roll-returns are measured relative to the 2nd nearest contract

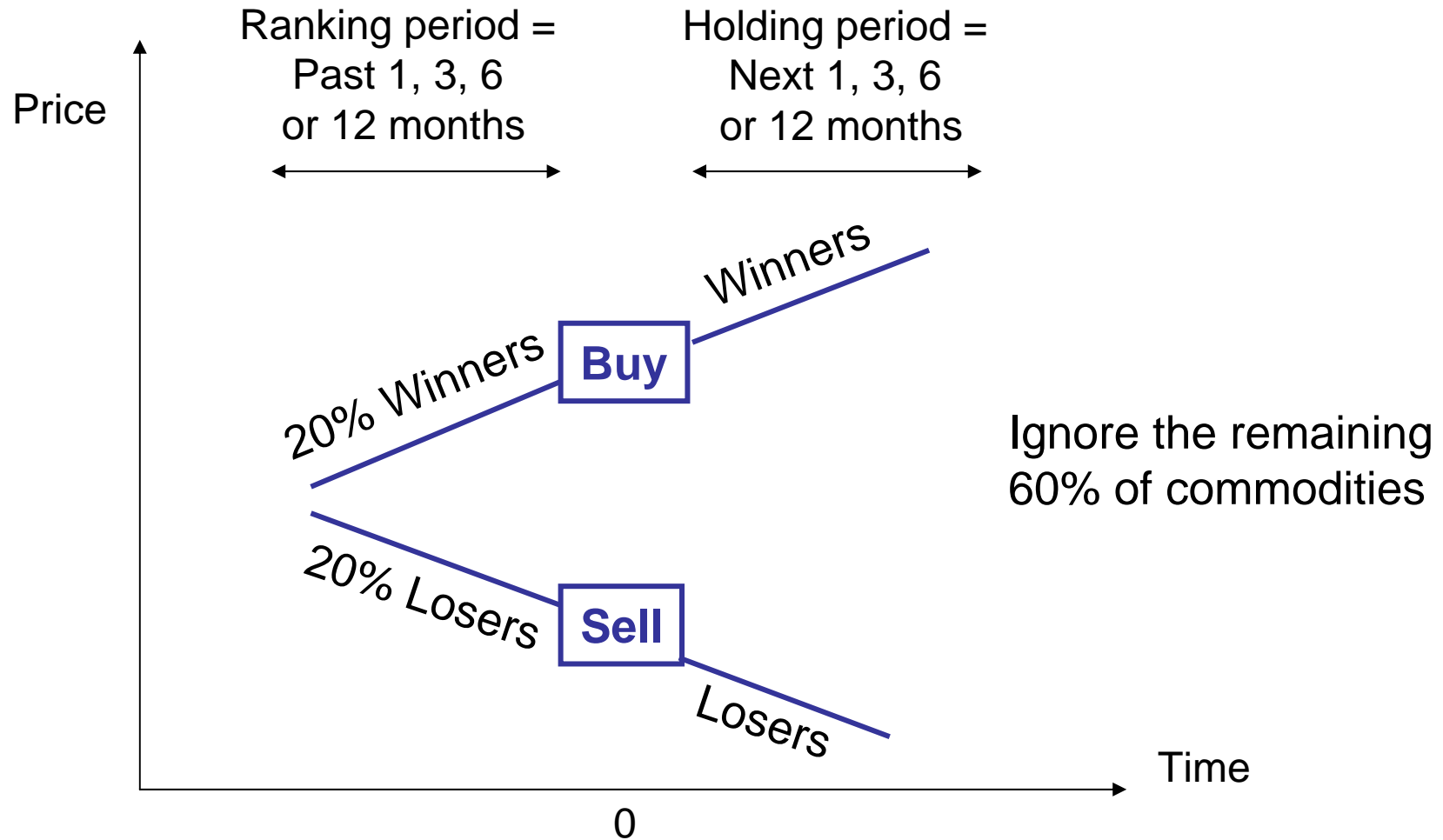
TS_2 : Roll-returns are measured relative to the most distant contract

* and **: Significant at the 1% and 5% levels

State-of-the-Art Commodities Investing

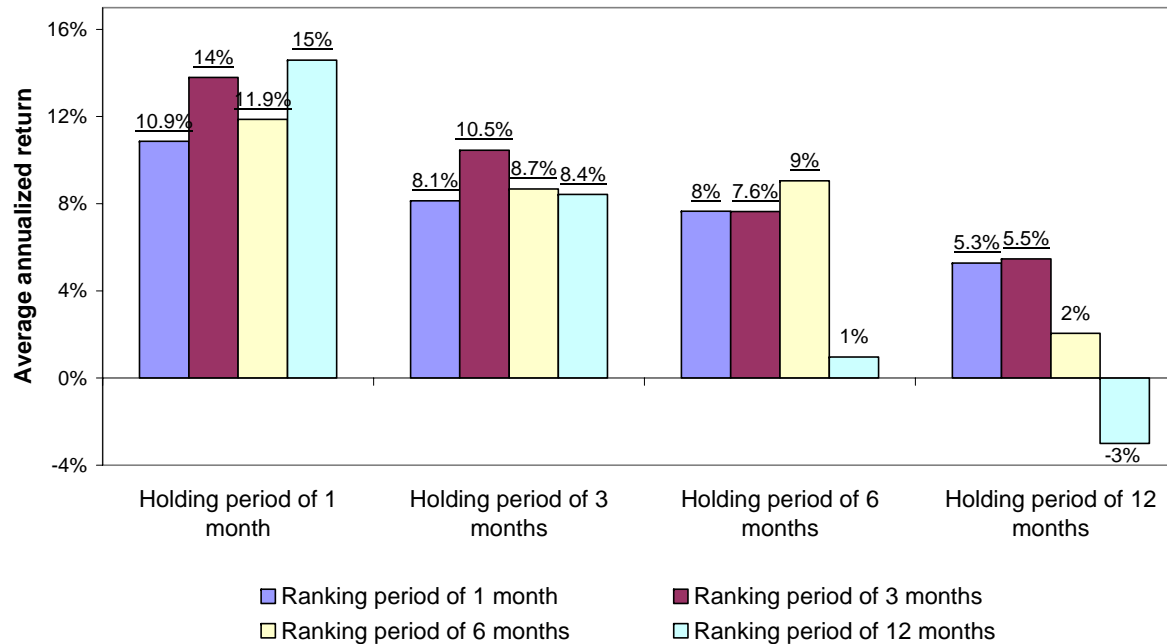
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Momentum means price continuation



Source: Miffre and Rallis, 2007, *Journal of Banking and Finance*, 31, 6, 1863-1886

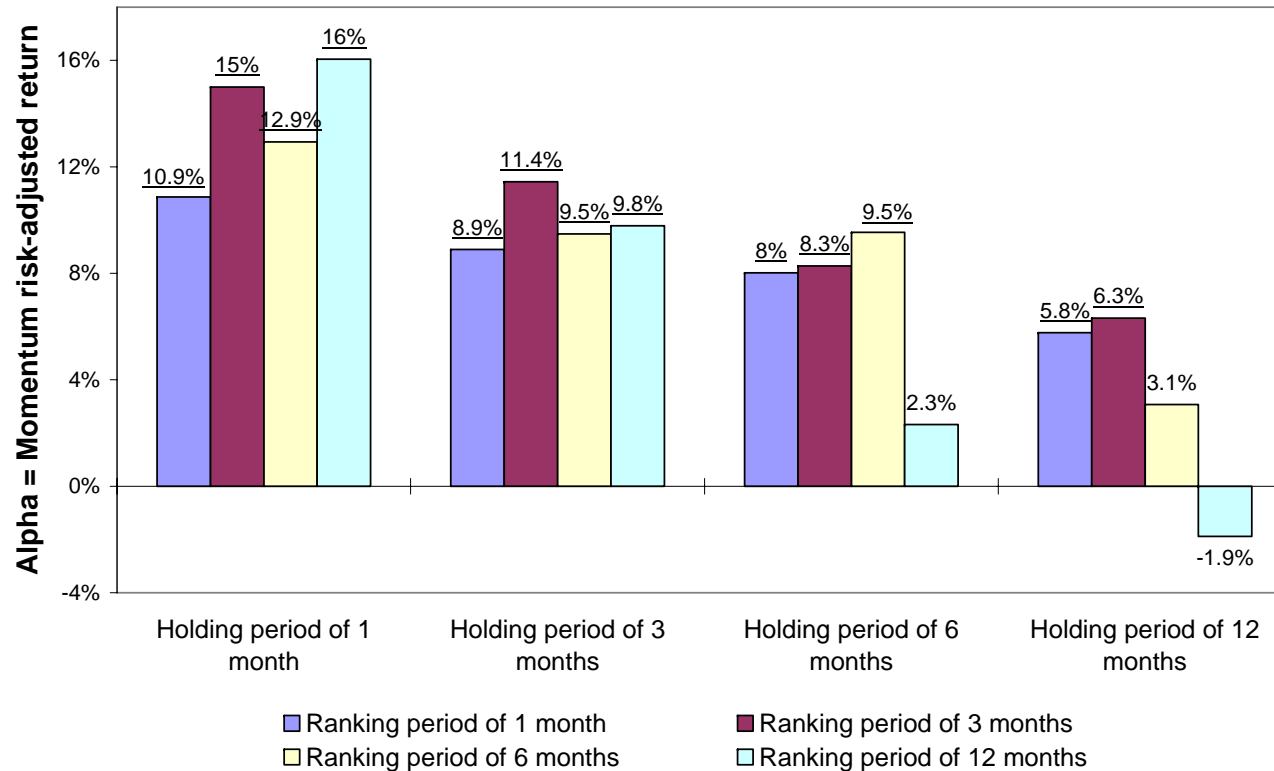
13 momentum strategies are profitable in commodity futures markets



- Average return of 13 profitable momentum strategies = 9.4%
- Equally-weighted portfolio of 31 commodity futures lost 2.5%!

Sample = Jan 1979 – Oct 2004
Underlined = Significant at 10%

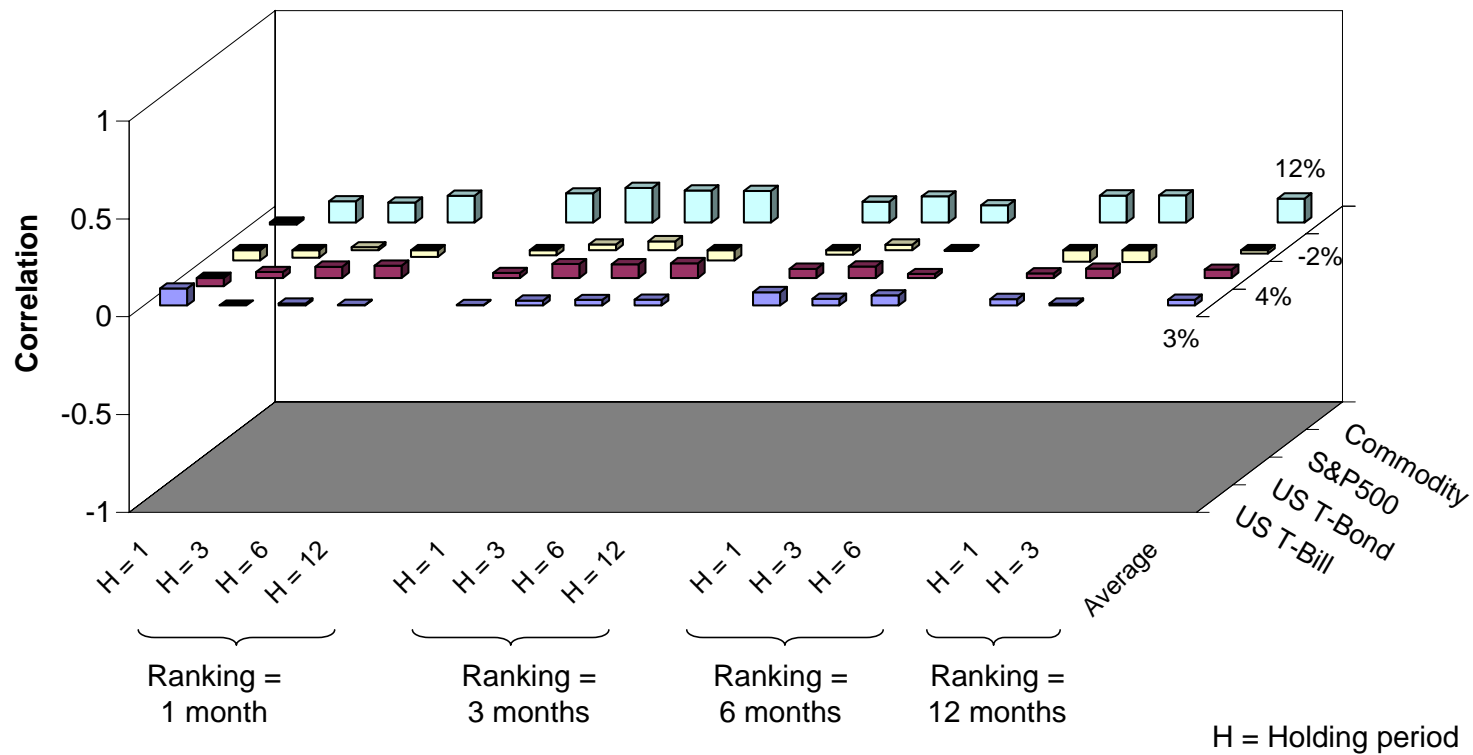
Momentum profits are not merely a compensation for market, interest rate and commodity risks



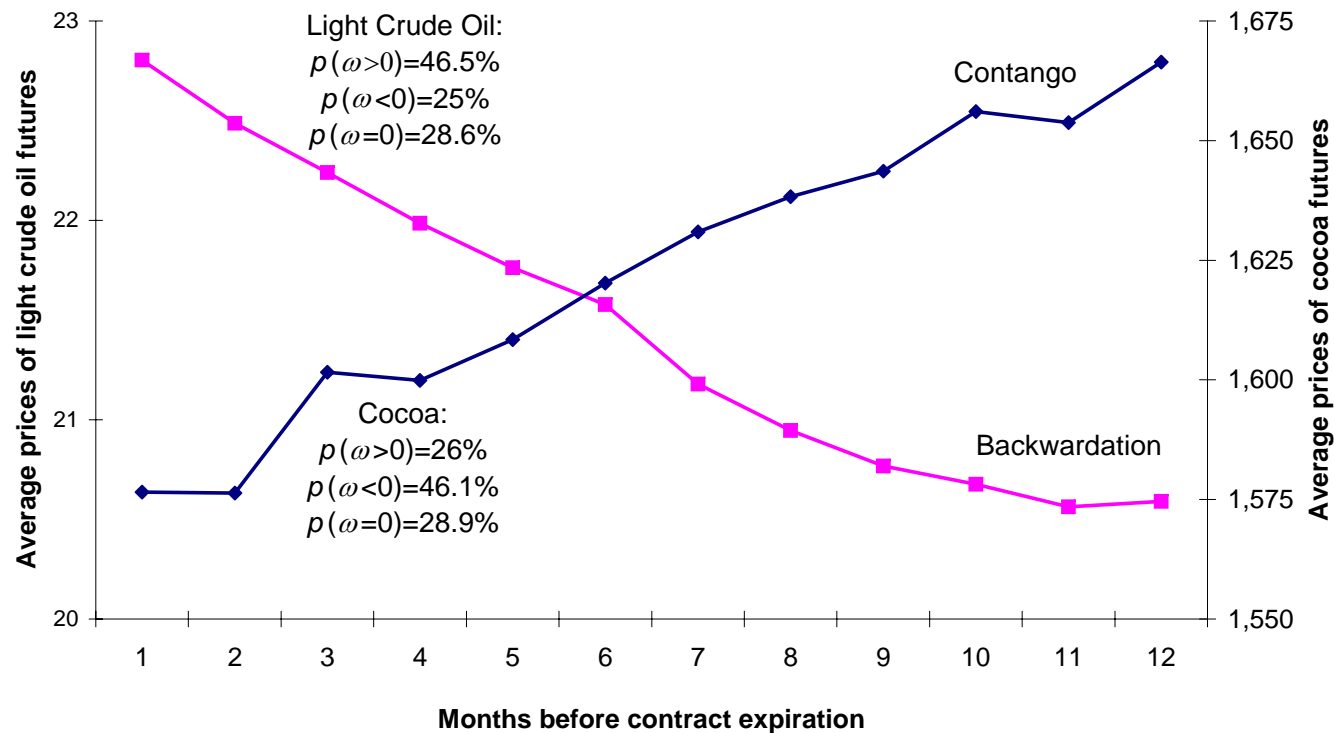
Average alpha of 13 profitable momentum strategies = 10.20%

Underlined = Significant at 10%

Momentum strategies preserve diversification properties of commodities



Which contracts do the strategies recommend trading? Term structure of average futures prices



$p(\omega > 0)$: Percentage of buy recommendations

$p(\omega < 0)$: Percentage of sell recommendations

$p(\omega = 0)$: Percentage of neither buy / nor sell recommendations

To recap thus far...

- Momentum strategies work well in commodity futures markets
- The strategies focus on commodity futures with steep upward or downward sloping term structures
- Like term structure strategies, momentum strategies
 - buy commodity futures with downward sloping term structure:
Backwardated markets
 - sell commodity futures with upward sloping term structure:
Contangoed markets

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Economic-based strategy

- Are economic indicators useful at predicting future commodity returns? Can we set up an active strategy in commodity futures markets that is based on business cycle variables and beat a long-only strategy?
- Weekly Wednesday prices on 25 commodity futures (agricultural, metal, gas, livestock)
- Lagged business cycle variables
 - Dividend yield, DY
 - Default spread, DS
 - Slope of the term structure, TS
 - Treasury-bill rate, TB
 - Commodity returns
- Period: Sep, 29 1990 – Dec, 27 2006

Economic-based strategy

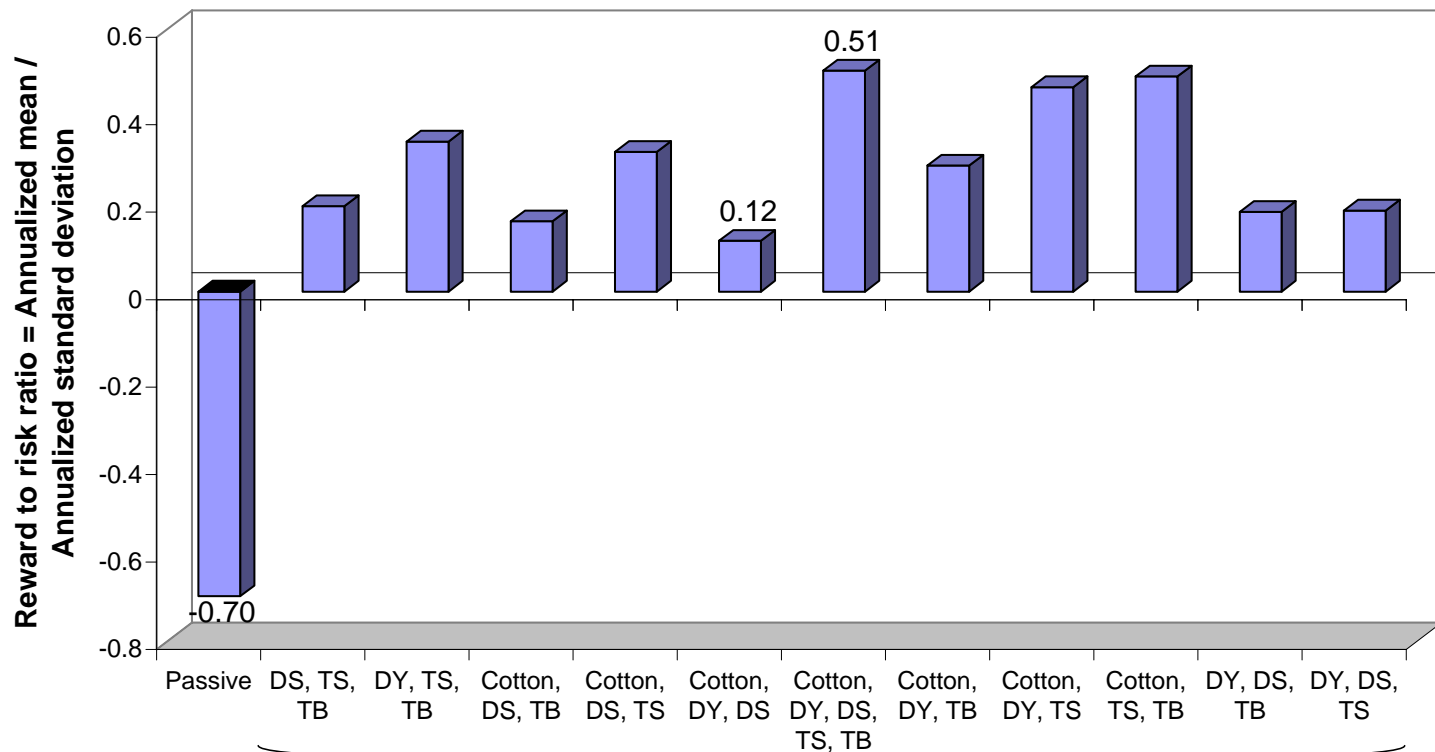
- Estimate a regression that relates each commodity returns $R_{Comm,t}$ to past values of the economic variables using 5 years of data

$$R_{Comm,t} = \beta_0 + \beta_1 DY_{t-1} + \beta_2 DS_{t-1} + \beta_3 TS_{t-1} + \varepsilon_t$$

- Use the regression coefficients (β_0 , β_1 , β_2 and β_3) to forecast one step-ahead commodity returns
 - If the forecast return is positive, buy the commodity
 - If the forecast return is negative, sell the commodity
- Repeat the strategy over the whole sample: Sep 1990 – Dec 2006
- Compare the performance of the active strategy to that of a passive long-only strategy
- Test the sensitivity of the results to the set of business cycle variables used

Results for a contangoed commodity: Cotton (Average return = -17.12%)

Reward to Risk Ratios of passive and 11 active strategies

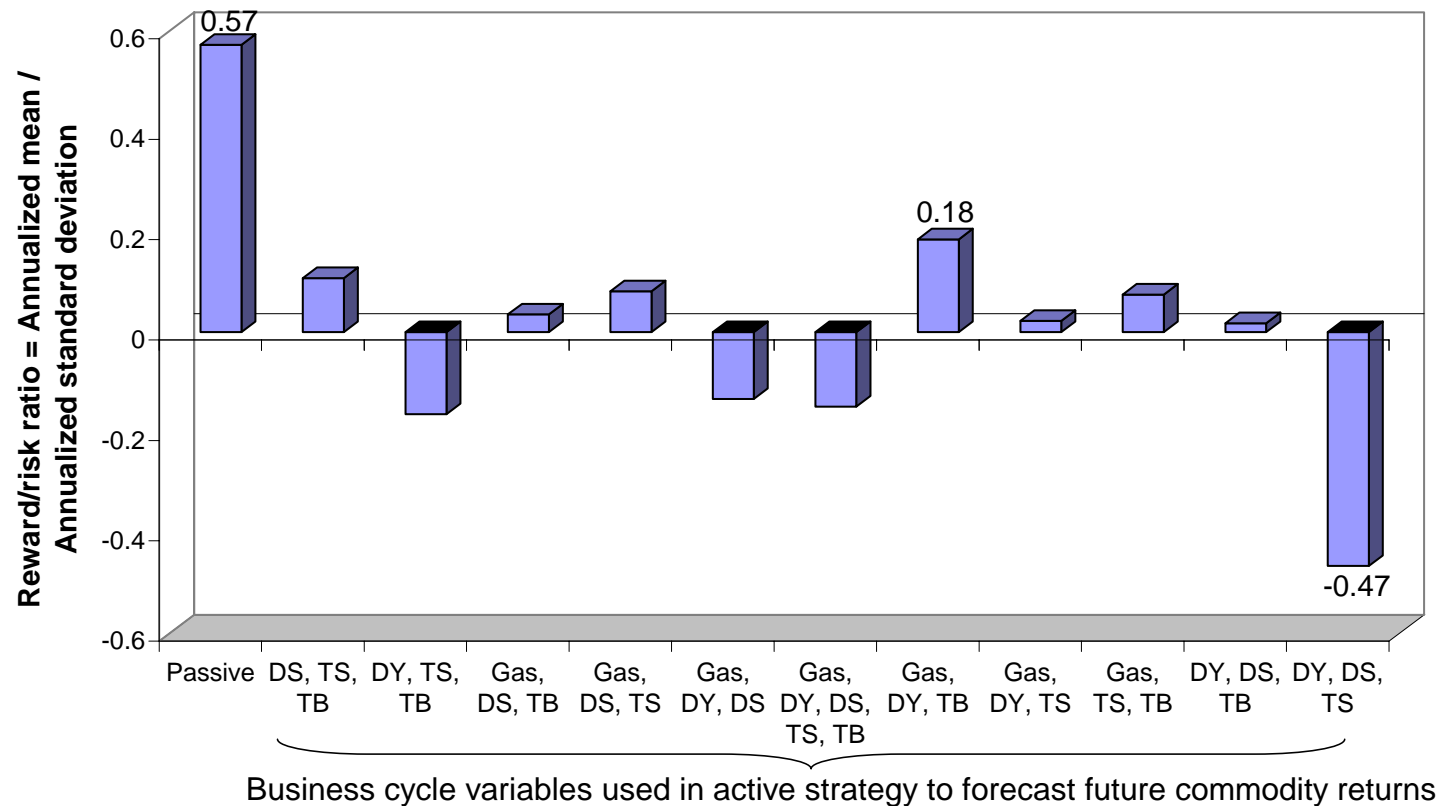


Business cycle variables used in active strategy to forecast future commodity returns

It is easy to beat a contangoed market

Results for a backwardated commodity: Unleaded gas (Average return = 21.21%)

Reward to Risk Ratios of passive and 11 active strategies



It is impossible to beat a backwardated market

Economic-based strategy: Conclusions

- Economic-based strategies work well in contangoed markets but work poorly in backwardated markets
- This is possibly due to the low correlations between commodity returns and the returns of traditional asset classes. As a result, economic variables that predict stock and bond returns have no forecast power over commodity returns and economic-based strategies fail to consistently outperform long-only strategies

Transaction costs

- Transaction costs impact the profitability of active strategies. The results presented here overstate the performance by the amount of trading costs. However the latter should not be overstated
- Transaction costs
 - Futures contracts: 0.0004% to 0.033%
 - Large-capitalization stocks: 0.5%
 - Small-capitalization stocks: 2.3%
- Less problem of liquidity
- No restrictions on short-selling
- Small cross section of commodity futures on which the strategies are implemented (up to 37 contracts)

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