Q Group
Spring Seminar
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Key Largo

The Tactical and Strategic Value of Commodity Futures

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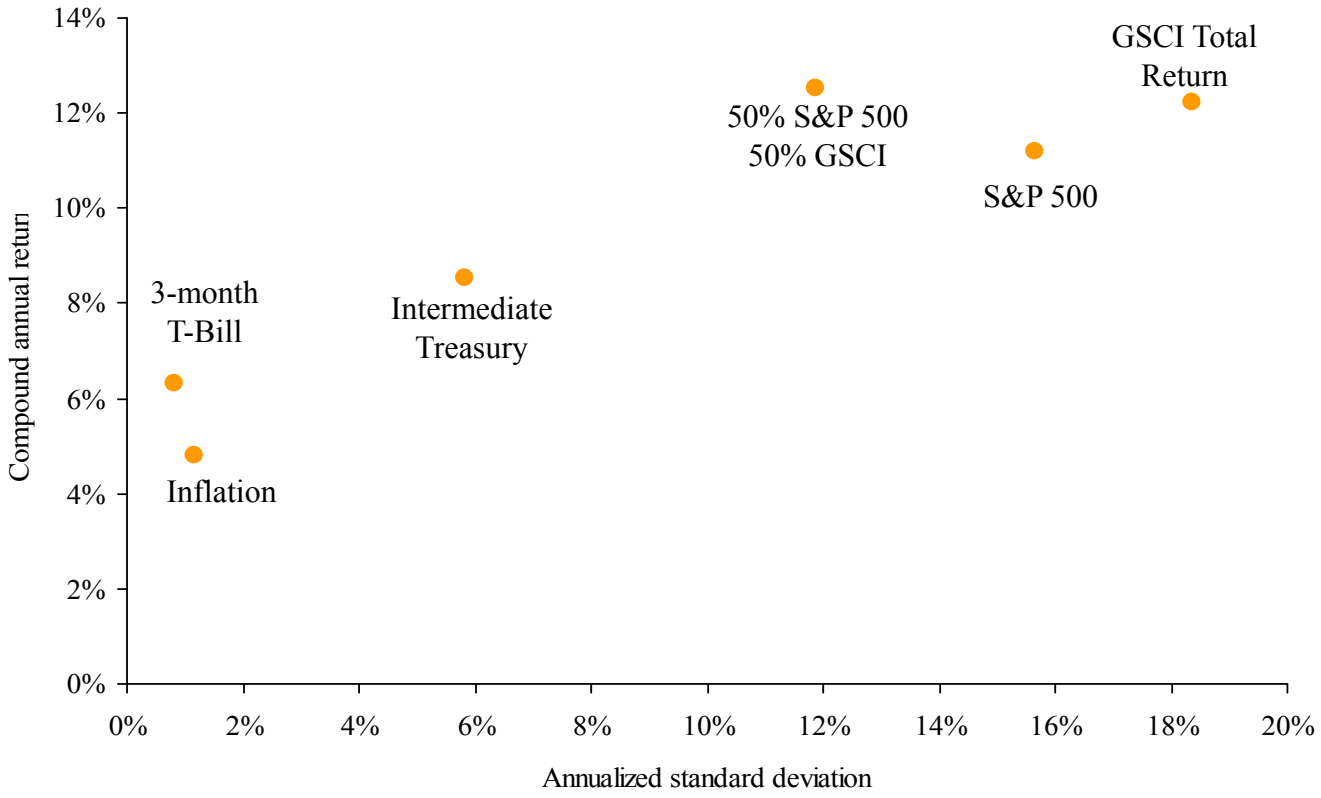
Overview

- The term structure of commodity prices has been the driver of past returns
  - and it will most likely be the driver of future returns
- Many previous studies suffer from serious shortcomings
  - Much of the analysis in the past has confused the "diversification return" (active rebalancing) with a risk premium
- Keynes' theory of "normal backwardation" is rejected in the data
  - Hence, difficult to justify a 'long-only' commodity futures exposure
- Commodity futures provide a dubious inflation hedge
- Commodity futures are tactical strategies that can be overlaid on portfolios
  - The most successful portfolios use information about the term structure

What can we learn from historical returns?
December 1969 to May 2004

- The GSCI is a cash collateralized portfolio of long-only commodity futures
  - Began trading in 1992, with history backfilled to 1969

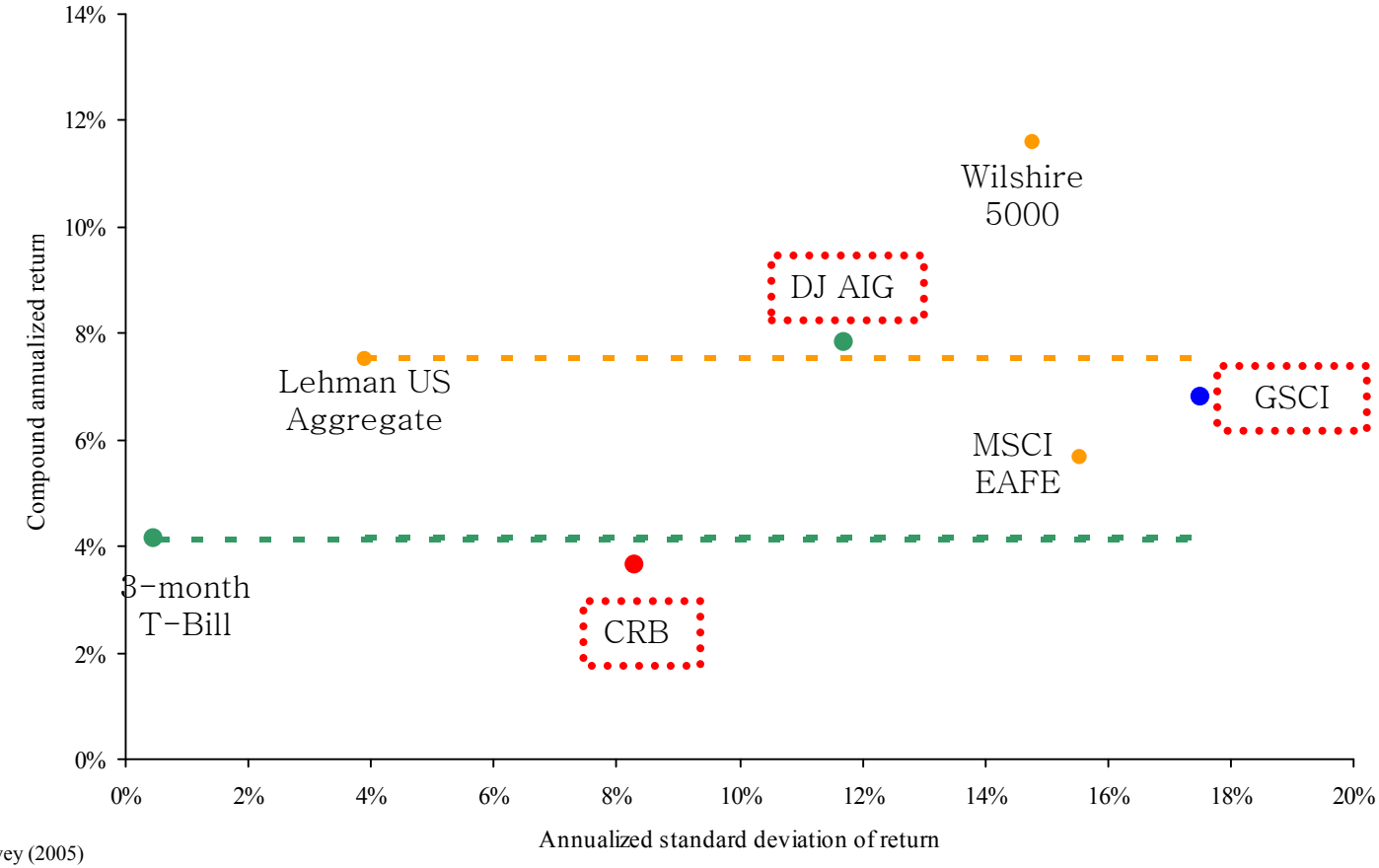


Note: GSCI is collateralized with 3-month T-bill.

What can we learn from historical returns?

January 1991 to May 2004

	Average return	Standard deviation	Correlation 1	2	3	4	5
1. GSCI	6.81%	17.53%					
2. DJ AIG	7.83%	11.71%	**0.89**				
3. CRB	3.64%	8.30%	**0.66**	**0.83**			
4. Wilshire 5000	11.60%	14.77%	0.06	0.13	0.18		
5. EAFE	5.68%	15.53%	0.14	0.22	0.27	**0.70**	
6. Lehman Aggregate	7.53%	3.92%	0.07	0.03	-0.02	0.07	0.03

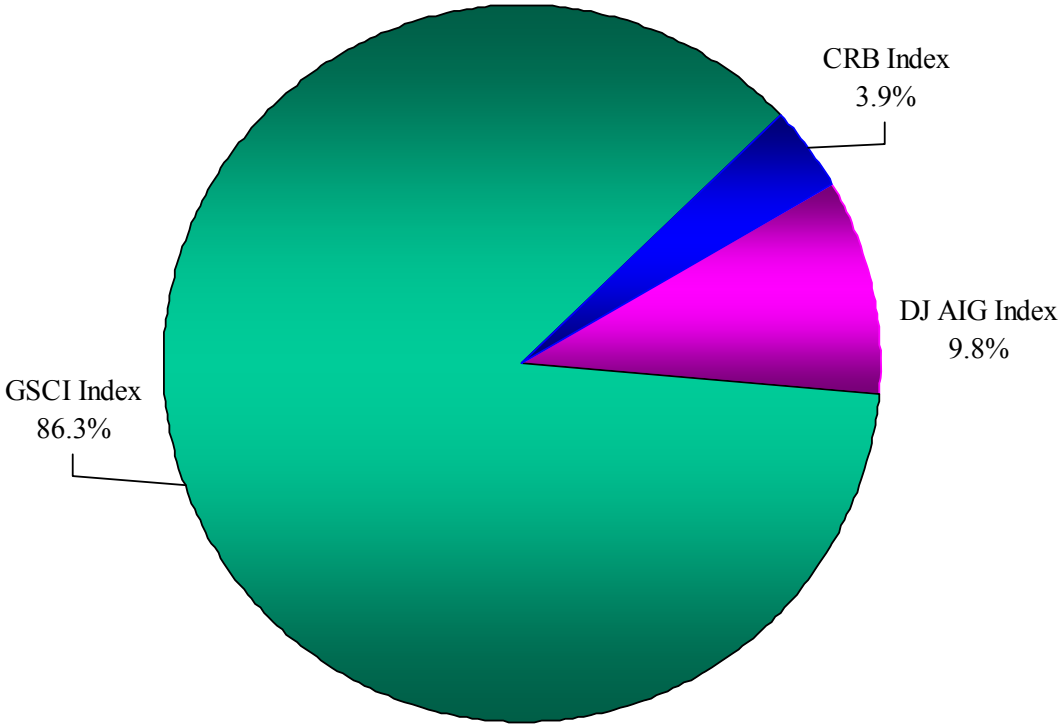


Erb-Harvey (2005)

Comparison begins in January 1991 because this is the initiation date for the DJ AIG Commodity Index. Cash collateralized returns

Market Value of Long Open Interest
As May 2004

- There are three commonly used commodity futures indices
  - The GSCI futures contract has the largest open interest value
  - The equally weighted CRB index is seemingly the least popular index
- Long open interest value is not market capitalization value
  - Long and short open interest values are always exactly offsetting



Data Source: Bloomberg

The Composition of Commodity Indices in May 2004

- Commodity futures index weighting schemes vary greatly
  - An important reason that commodity index returns vary
  - Commodity indices are active portfolios

	Portfolio Weights			
Commodity	**CRB**	**GSCI**	**DJ AIG**	**"Market"**
Aluminum	-	2.9%	7.1%	11.4%
Cocoa	5.9%	0.3%	2.0%	0.9%
Coffee	5.9%	0.6%	2.8%	2.1%
Copper	5.9%	2.3%	6.7%	10.4%
Corn	5.9%	3.1%	5.1%	2.6%
Cotton	5.9%	1.1%	1.8%	1.1%
Crude Oil	5.9%	28.4%	16.7%	16.8%
Brent Crude Oil	-	13.1%	-	7.7%
Feeder Cattle	-	0.8%	-	0.5%
Gas Oil	-	4.5%	-	3.3%
Gold	5.9%	1.9%	5.3%	5.1%
Heating Oil	5.9%	8.1%	4.7%	4.3%
Lead	-	0.3%	-	0.6%
Hogs	5.9%	2.1%	5.1%	0.9%
Live Cattle	5.9%	3.6%	6.7%	1.9%
Natural Gas	5.9%	9.5%	9.9%	12.4%
Nickel	-	0.8%	1.9%	2.1%
Orange Juice	5.9%	-	-	0.2%
Platinum	5.9%	0.0%	-	0.1%
Silver	5.9%	0.2%	2.2%	1.3%
Soybeans	5.9%	1.9%	5.1%	3.4%
Soybean Oil	-	0.0%	1.7%	0.8%
Sugar	5.9%	1.4%	3.8%	1.3%
Tin	-	-	-	0.3%
Unleaded Gas	-	8.5%	5.4%	4.2%
Wheat	5.9%	2.9%	3.8%	1.6%
Red Wheat	-	1.3%	0.0%	0.2%
Zinc	-	0.5%	2.3%	2.5%
Total	100%	100%	100%	100%
# Contracts	17	24	20	28

Portfolio Weight Correlation

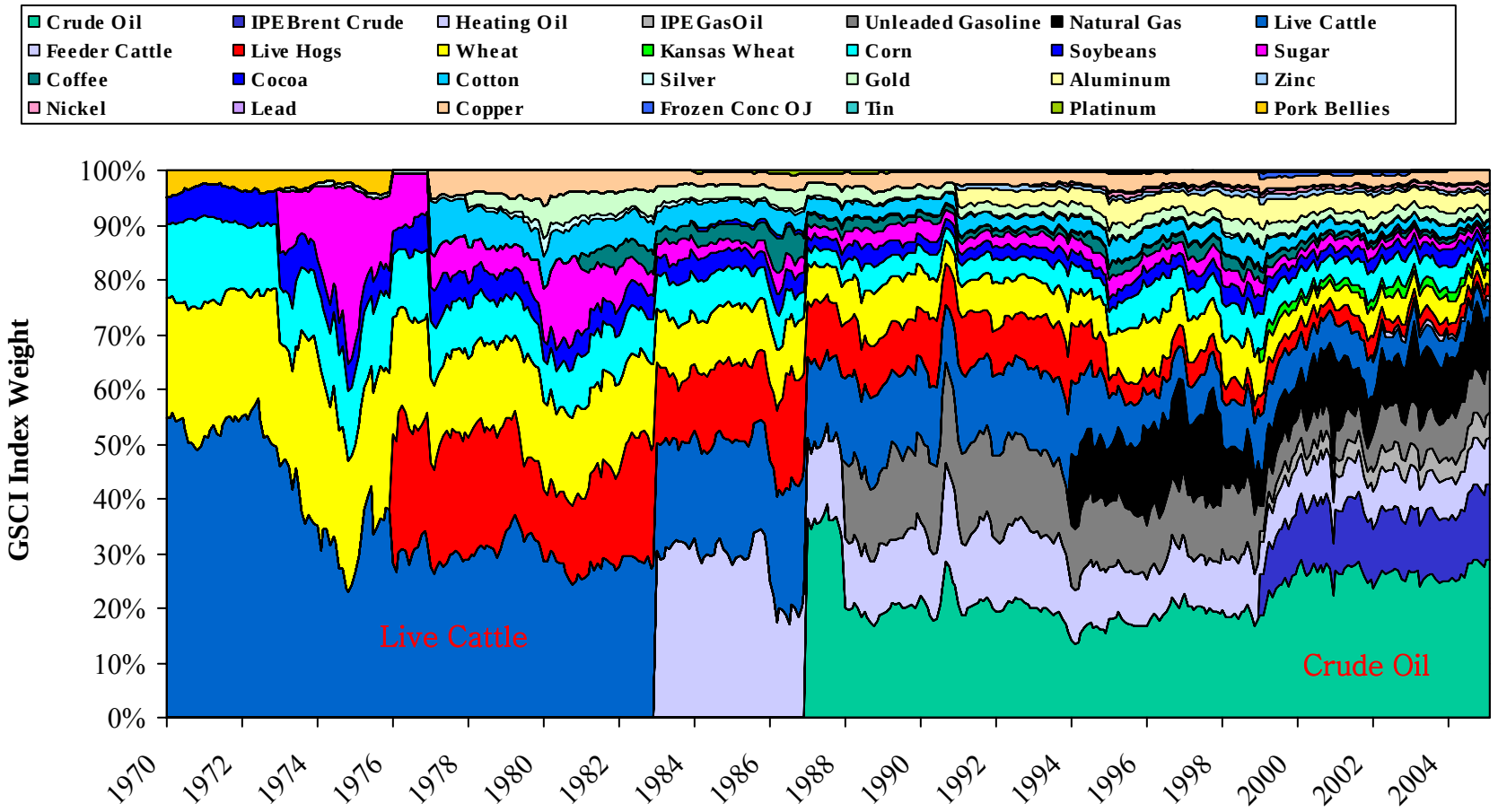
	CRB	GSCI	DJ AIG	"Market"
CRB	1.00			
GSCI	0.08	1.00		
DJ AIG	0.42	0.72	1.00	
"Market"	0.10	0.78	0.81	1.00

Erb-Harvey (2005)

Data Source: Goldman Sachs, Dow Jones AIG, CRB

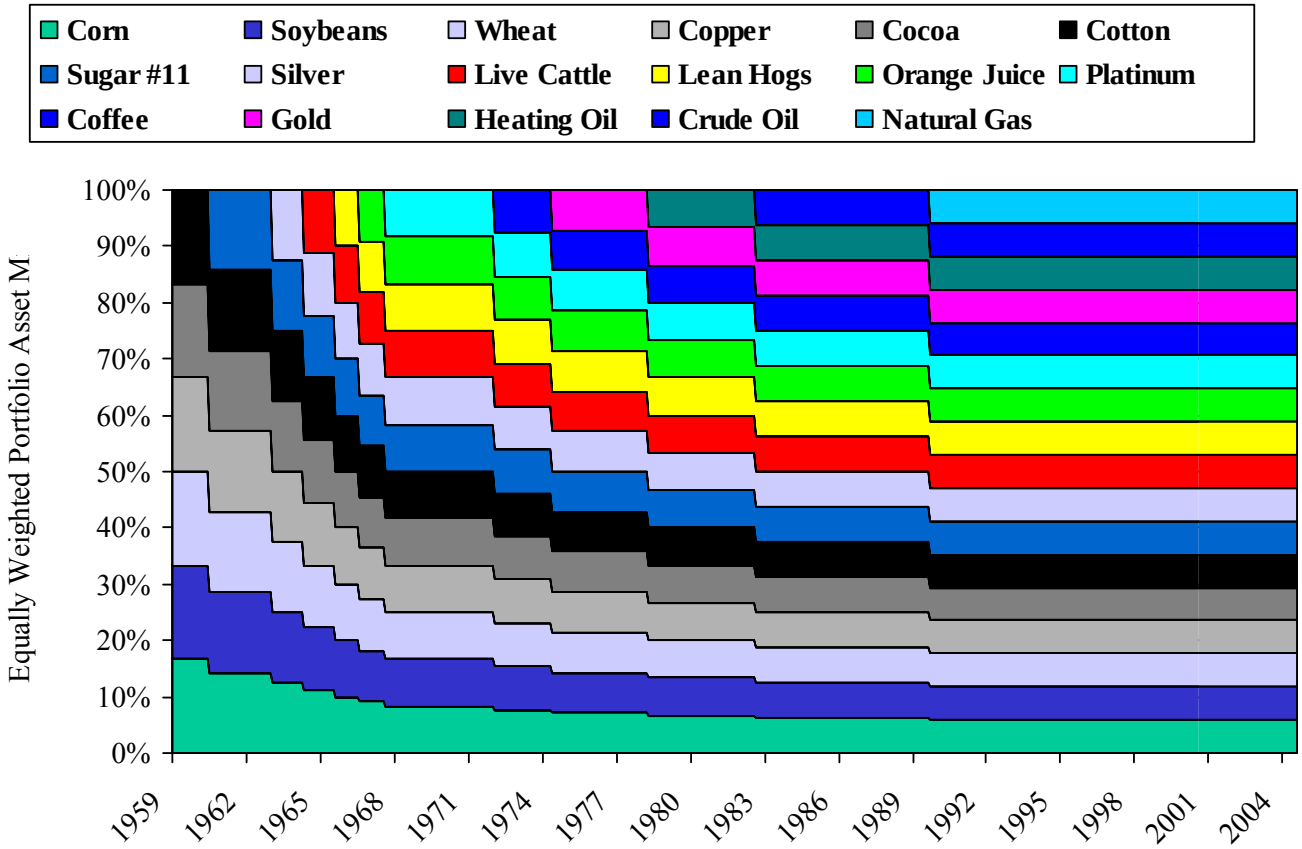
GSCI Portfolio Weights Have Changed Over Time

- Individual GSCI commodity portfolio weights vary as a result of
  - (1) Changes in "production value" weights and (2) New contract introductions
- As a result, it is hard to determine the "commodity asset class" return



CRB Portfolio Weights Have Changed Over Time

- CRB index weights look like they have changed in an orderly way
- However, this only shows weights consistent with the current composition of the CRB
  - Actual historical CRB weight changes have been more significant,
    - for example, in 1959 there were 26 commodities

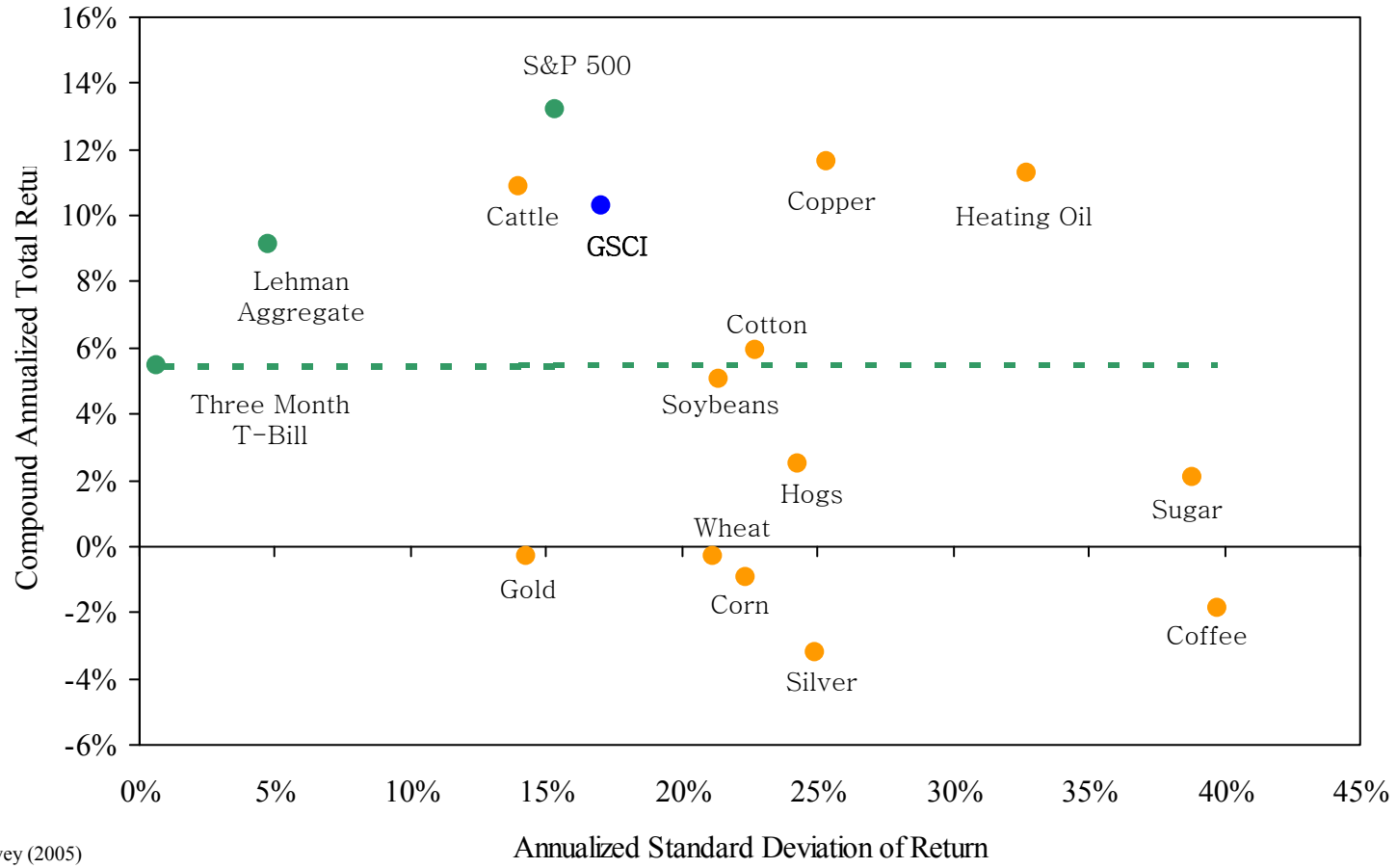


Note: Commodity Research Bureau data, www.crbtrader.com/crbin

Cash Collateralized Commodity Futures Total Returns

December 1982 to May 2004

- If individual commodity futures returns cluster around the returns of an index, an index might be a good representation of the "commodity asset class" return



Commodities Index Return vs. Asset Class Return

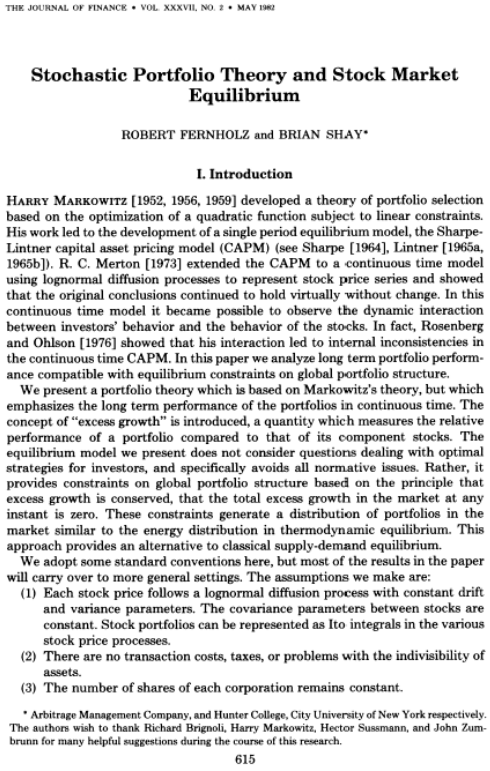
- A commodity futures index is just a portfolio of commodity futures. Returns are driven by:
  1. The portfolio weighting scheme and
  2. The return of individual securities

- It is important to separate out the "active" component (portfolio weights change) from the underlying "asset class" returns

- Ultimately, a "commodity asset class" return estimate requires a view as to what drives individual commodity returns

The Diversification Return

- Fixed weight rebalancing (active strategy) can enhance returns
  - Fernholz (*Journal of Finance*, May 1982)
  - Booth and Fama (*Financial Analysts Journal*, May/June 1992)



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Stochastic Portfolio Theory and Stock Market Equilibrium

ROBERT FERNHOLZ and BRIAN SHAY*

I. Introduction

HARRY MARKOWITZ [1952, 1956, 1959] developed a theory of portfolio selection based on the optimization of a quadratic function subject to linear constraints. His work led to the development of a single period equilibrium model, the Sharpe-Lintner capital asset pricing model (CAPM) (see Sharpe [1964], Lintner [1965a, 1965b]). R. C. Merton [1973] extended the CAPM to a continuous time model using lognormal diffusion processes to represent stock price series and showed that the original conclusions continued to hold virtually without change. In this continuous time model it became possible to observe the dynamic interaction between investors' behavior and the behavior of the stocks. In fact, Rosenberg and Ohlson [1976] showed that his interaction led to internal inconsistencies in the continuous time CAPM. In this paper we analyze long term portfolio performance compatible with equilibrium constraints on global portfolio structure.

We present a portfolio theory which is based on Markowitz's theory, but which emphasizes the long term performance of the portfolios in continuous time. The concept of "excess growth" is introduced, a quantity which measures the relative performance of a portfolio compared to that of its component stocks. The equilibrium model we present does not consider questions dealing with optimal strategies for investors, and specifically avoids all normative issues. Rather, it provides constraints on global portfolio structure based on the principle that excess growth is conserved, that the total excess growth in the market at any instant is zero. These constraints generate a distribution of portfolios in the market similar to the energy distribution in thermodynamic equilibrium. This approach provides an alternative to classical supply-demand equilibrium.

We adopt some standard conventions here, but most of the results in the paper will carry over to more general settings. The assumptions we make are:

(1) Each stock price follows a lognormal diffusion process with constant drift and variance parameters. The covariance parameters between stocks are constant. Stock portfolios can be represented as Ito integrals in the various stock price processes.

(2) There are no transaction costs, taxes, or problems with the indivisibility of assets.

(3) The number of shares of each corporation remains constant.

* Arbitrage Management Company, and Hunter College, City University of New York respectively. The authors wish to thank Richard Brignoli, Harry Markowitz, Hector Sussmann, and John Zumbrunn for many helpful suggestions during the course of this research.

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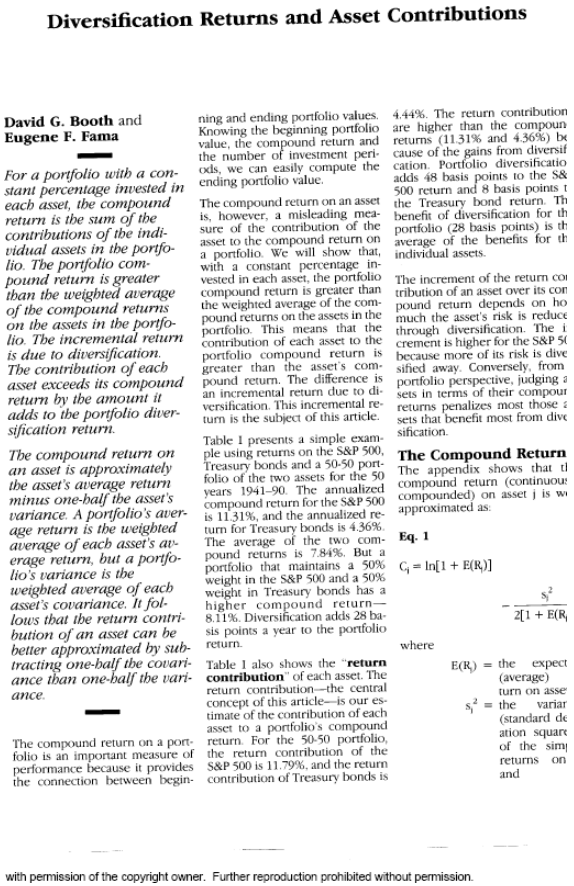


Diversification Returns and Asset Contributions

David G. Booth and **Eugene F. Fama**

For a portfolio with a constant percentage invested in each asset, the compound return is the sum of the contributions of the individual assets in the portfolio. The portfolio compound return is greater than the weighted average of the compound returns on the assets in the portfolio. The incremental return is due to diversification. The contribution of each asset exceeds its compound return by the amount it adds to the portfolio diversification return.

The compound return on an asset is approximately the asset's average return minus one-half the asset's variance. A portfolio's average return is the weighted average of each asset's average return, but a portfolio's variance is the weighted average of each asset's covariance. It follows that the return contribution of an asset can be better approximated by subtracting one-half the covariance than one-half the variance.

The compound return on a portfolio is an important measure of performance because it provides the connection between beginning and ending portfolio values. Knowing the beginning portfolio value, the compound return and the number of investment periods, we can easily compute the ending portfolio value.

The compound return on an asset is, however, a misleading measure of the contribution of the asset to the compound return on a portfolio. We will show that, with a constant percentage invested in each asset, the portfolio compound return is greater than the weighted average of the compound returns on the assets in the portfolio. This means that the contribution of each asset to the portfolio compound return is greater than the asset's compound return. The difference is an incremental return due to diversification. This incremental return is the subject of this article.

Table 1 presents a simple example using returns on the S&P 500, Treasury bonds and a 50-50 portfolio of the two assets for the 50 years 1941–90. The annualized compound return for the S&P 500 is 11.31%, and the annualized return for Treasury bonds is 4.36%. The average of the two compound returns is 7.84%. But a portfolio that maintains a 50% weight in the S&P 500 and a 50% weight in Treasury bonds has a higher compound return—8.11%. Diversification adds 28 basis points a year to the portfolio return.

Table 1 also shows the "**return contribution**" of each asset. The return contribution—the central concept of this article—is our estimate of the contribution of each asset to a portfolio's compound return. For the 50-50 portfolio, the return contribution of the S&P 500 is 11.79%, and the return contribution of Treasury bonds is 4.44%. The return contribution are higher than the compoun returns (11.31% and 4.36%) be cause of the gains from diversif cation. Portfolio diversificatio adds 48 basis points to the S& 500 return and 8 basis points t the Treasury bond return. Th benefit of diversification for th portfolio (28 basis points) is th average of the benefits for th individual assets.

The increment of the return co tribution of an asset over its con pound return depends on ho much the asset's risk is reduce through diversification. The i crement is higher for the S&P 5 because more of its risk is dive sified away. Conversely, from portfolio perspective, judging a sets in terms of their compour returns penalizes most those a sets that benefit most from dive sification.

The Compound Return

The appendix shows that tl compound return (continuou compounded) on asset j is w approximated as:

Eq. 1

$$C_j = \ln[1 + E(R_j)] - \frac{s_j^2}{2[1 + E(R_j$$

where

$E(R_j)$ = the expect (average) turn on asse

s_j^2 = the variar (standard de ation squar of the sim returns on and

How Portfolio Construction Might Impact Portfolio Returns -
The Diversification Return (Booth and Fama, 1992)

- "For a portfolio with a constant percentage invested in each asset, the compound return is the sum of the contributions of the individual assets in the portfolio. The portfolio compound return is greater than the weighted average of the compound returns on the assets in the portfolio. The incremental return is due to diversification. The contributions of each asset exceeds its compound return by the amount it adds to the portfolio diversification return."

- "The compound return on an asset is approximately the asset's average return minus one half the asset's variance. A portfolio's average return is the weighted average of each asset's average return, but a portfolio's variance is the weighted average of each asset's covariance."

Note: Emphasis added.

Examples of the Pay-Off to Portfolio Rebalancing

- An interesting rebalancing strategy has "outperformed" by about 7% per annum

  Return = "Some Benchmark/The Market" + Rebalancing Strategy Pay-Off

- <u>The pay-off to rebalancing is not a risk premium – it is an active strategy</u>

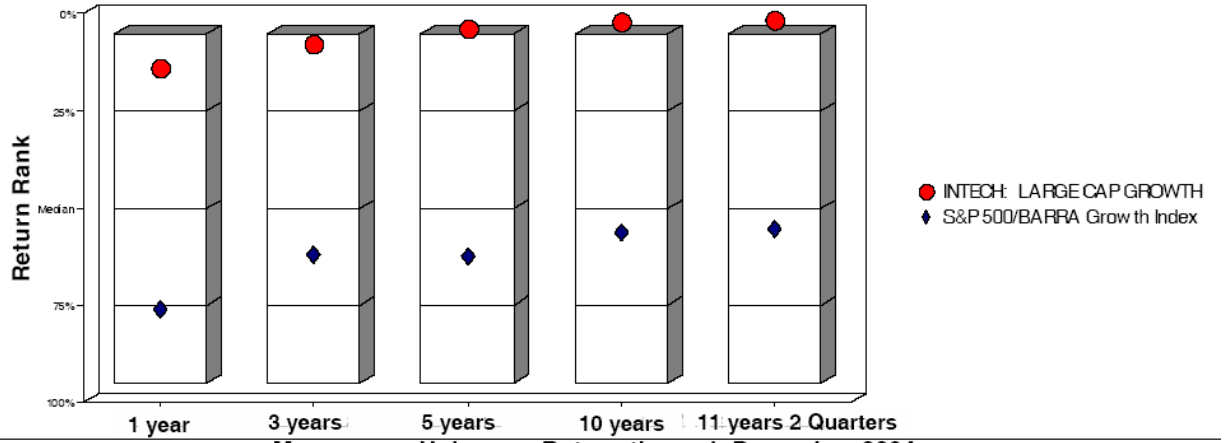
INTECH Large Cap Growth Composite

Zephyr StyleADVISOR Enhanced Investment Technologies, Ir

Manager vs Universe: Return Rank through December 2004

(not annualized if less than 1 year)

Zephyr Large Growth Universe (PSN)



Manager vs Universe: Return through December 2004

(not annualized if less than 1 year)

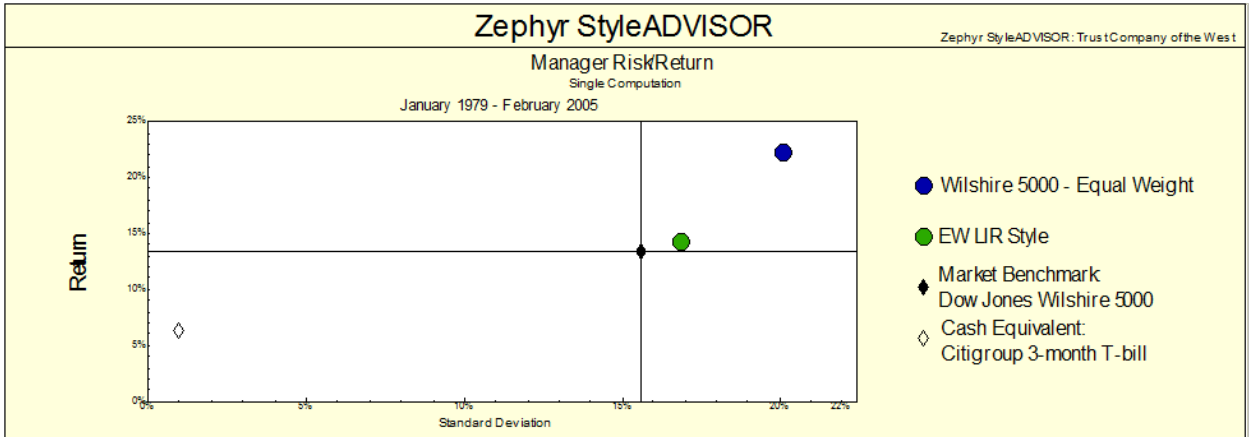
	1 year 293 mng	3 years 281 mng	5 years 258 mng	10 years 156 mng	11 years 2 Quarters 127 mng
INTECH: LARGE CAP GROWTH	15.84%	8.43%	2.95%	19.54%	17.12%
S&P 500/BARRA Growth Index	6.13%	0.63%	-7.07%	11.44%	10.58%

Zephyr Large Growth Universe (PSN)

Note: Intech LCG Composite is a "diversity" weighted portfolio, a form of "relative" fixed weight rebalancing

Examples of the Pay-Off to Portfolio Rebalancing

- The equally weighted Wilshire 5000 "outperformed" by about 9% per annum



Risk-Return Table

January 1979 - February 2005: Annualized Summary Statistics

	Return (%)	Std Dev (%)	Beta vs. Market	Alpha vs. Market (%)	R-Squared vs. Market (%)	Sharpe Ratio	Tracking Error vs. Market (%)	Observs.
Wilshire 5000 - Equal Weight	22.23	20.08	1.0416	8.28	65.28	0.7898	11.8967	314
EW LIR Style	14.35	16.85	1.0500	0.60	94.48	0.4735	4.0458	314
Dow Jones Wilshire 5000	13.48	15.61	1.0000	0.00	100.00	0.4554	0.0000	314

ebalanced Equally Weighted Portfolio

Let-It-Run Initially
qually Weighted Sector Portfolio

The "Market"

Note: EW LIR Style = Initially equally weighted Let-It-Run Wilshire 5000 Style portfolio. This portfolio Initially invests equal amounts in the six Wilshire style indices: large/mid/small-growth/value. The portfolio is not rebalanced.

Examples of the Pay-Off to Portfolio Rebalancing

- A 50% heating oil/50% stock portfolio had an excess return of 10.95%
  - Heating oil had an excess return of 8.21%, this might have been a "risk premium"
  - Stocks had an excess return of 6.76%, this might have been a "risk premium"
- The diversification return was about 3.5%

	Heating Oil Excess Return	S&P 500 Excess Return		EW Portfolio Excess Return
1994	19.96%	-2.92%		8.52%
1995	7.73%	31.82%		19.78%
1996	67.37%	17.71%		42.54%
1997	-35.06%	28.11%		-3.48%
1998	-50.51%	23.51%		-13.50%
1999	73.92%	16.30%		45.11%
2000	66.71%	-15.06%		25.82%
2001	-36.62%	-15.97%		-26.30%
2002	41.40%	-23.80%		8.80%
2003	21.90%	27.62%		24.76%
Portfolio Weight	50%	50%	Weighted Average of Individual Returns	
Geometric Return	**8.21%**	**6.76%**	**7.49%**	**10.95%**
Variance	21.22%	4.44%	**12.83%**	**5.34%**
Beta (EW Portfolio)	1.79	0.21	1.00	1.00
Covariance	9.54%	1.14%	5.34%	5.34%

Diversification Return = EW Portfolio Return - Weighted Average Return = **10.95%** - **7.49%** = **3.46%**

Approximate Diversification Return = (Average Variance - Average Covariance)/2 = (**12.83%** - **5.34%**) /2 = **3.74%**

The Mathematics of the Diversification Return

- Stand alone asset geometric return

  = Average Return – Variance/2
  = $R_i - \sigma^2_i /2$

- Asset geometric return in a portfolio context

  = Average Return – Covariance/2
  = $R_i - \beta_i \sigma^2_{Portfolio} /2$

- Stand alone asset diversification return

  = (Average Return – Covariance/2) – (Average Return – Variance/2)
  = $(R_i - \beta_i \sigma^2_{Portfolio} /2) - (R_i - \sigma^2_i /2)$
  = $\sigma^2_i /2 - \beta_i \sigma^2_{Portfolio} /2$
  = $(\sigma^2_i - \beta_i \sigma^2_{Portfolio})/2$
  = Residual Variance/2

- Portfolio diversification return

  = (Weighted Average Asset Variance – Weighted Average Asset Covariance)/2
  = (Weighted Average Asset Variance – Portfolio Variance)/2

An Analytical Approach to the Diversification Return

- The variance of an equally weighted portfolio is

  Portfolio Variance = Average Variance/N + (1-1/N) Average Covariance

  = Average Variance/N + (1-1/N) Average Correlation * Average Variance

- Equally weighted portfolio diversification return

  = (Weighted Average Asset Variance – Portfolio Variance)/2

  = (Average Variance – (Average Variance/N + (1-1/N) Average Covariance))/2

  = (1-1/N) *(Average Variance - Average Covariance)/2

  = ((1-1/N) *(Average Variance) - (1-1/N) Average Correlation * Average Variance)/2

- As the number of securities, N, becomes large, this reduces to

  = (Average Variance – Average Correlation * Average Variance)/2

  = Average Diversifiable Risk/2

What are "Average" Commodity Futures Correlations? Excess Return Correlations

Monthly observations, December 1982 to May 2004

- Historically, commodity futures excess return correlations have been low

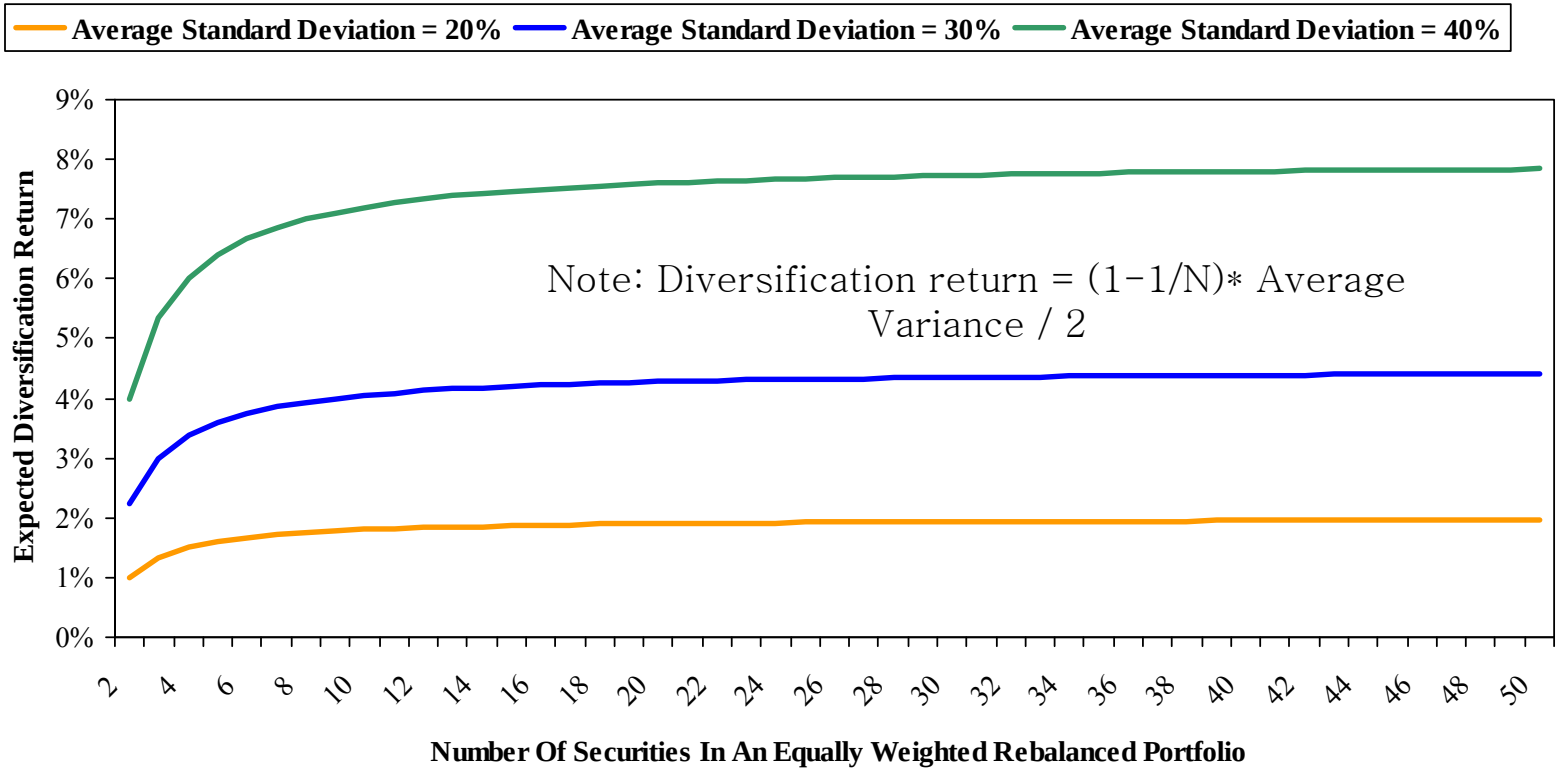
	GSCI	Non-Energy	Energy	Livestock	Agriculture	Industrial Metals	Precious Metals	Heating Oil	Cattle	Hogs	Wheat	Corn	Soybeans	Sugar	Coffee	Cotton	Gold	Silver
Non-Energy	0.36																	
Energy	0.91	0.06																
Livestock	0.20	0.63	0.01															
Agriculture	0.24	0.78	0.01	0.12														
Industrial Metals	0.13	0.31	0.03	-0.02	0.17													
Precious Metals	0.19	0.20	0.14	0.03	0.08	0.20												
Heating Oil	0.87	0.08	0.94	0.04	0.00	0.05	0.13											
Cattle	0.12	0.50	-0.03	0.84	0.07	0.03	0.01	0.00										
Hogs	0.21	0.52	0.06	0.81	0.13	-0.06	0.05	0.06	0.37									
Wheat	0.25	0.66	0.06	0.18	0.79	0.05	0.06	0.06	0.12	0.17								
Corn	0.14	0.58	-0.03	0.10	0.78	0.12	-0.01	-0.04	0.05	0.11	0.52							
Soybeans	0.20	0.58	0.02	0.11	0.72	0.18	0.14	0.05	0.03	0.14	0.43	0.70						
Sugar	0.03	0.21	-0.06	-0.05	0.35	0.14	0.05	-0.04	0.02	-0.10	0.11	0.12	0.09					
Coffee	-0.01	0.15	-0.04	-0.07	0.23	0.07	0.01	-0.07	-0.06	-0.06	0.00	0.03	0.07	-0.01				
Cotton	0.11	0.25	0.06	0.00	0.27	0.17	0.04	0.05	-0.06	0.06	0.05	0.11	0.18	-0.02	-0.01			
Gold	0.20	0.16	0.16	0.01	0.07	0.18	0.97	0.15	-0.02	0.04	0.07	-0.01	0.14	0.02	0.00	0.03		
Silver	0.08	0.19	0.02	0.02	0.10	0.19	0.77	0.02	-0.01	0.05	0.03	0.09	0.13	0.07	0.04	0.04	0.66	
Copper	0.15	0.36	0.04	0.01	0.22	0.94	0.20	0.07	0.03	-0.02	0.08	0.16	0.23	0.14	0.11	0.19	0.18	0.21

Average Correlations

GSCI v. commodity sectors	0.33
GSCI v. individual commodities	0.13
Heating oil v. other commodities	0.03
Individual commodities	0.09

Expected Diversification Returns

- Assume a universe of uncorrelated securities
- The size of the diversification return grows with the number of portfolio assets
  - Two securities capture 50% of the maximum diversification return
  - Nine securities capture 90% of the maximum diversification return



Four Ways to Calculate the Diversification Return

December 1982 to May 2004

- There are at least four ways to calculate the diversification return
  - Difference of weighted average and portfolio geometric returns
  - One half the difference of weighted average and portfolio variances
  - One half the residual variance
  - The "average correlation" method

Commodity	Fixed Portfolio Weights	Geometric Excess Return	Variance	Residual Variance	Average Correlation
Heating Oil	8.33%	5.53%	10.59%	9.65%	0.03
Cattle	8.33%	5.07%	1.95%	1.88%	0.04
Hogs	8.33%	-2.75%	5.86%	5.33%	0.07
Wheat	8.33%	-5.39%	4.43%	3.38%	0.15
Corn	8.33%	-5.63%	5.13%	3.66%	0.17
Soybeans	8.33%	-0.35%	4.62%	2.92%	0.20
Sugar	8.33%	-3.12%	14.94%	12.70%	0.04
Coffee	8.33%	-6.36%	15.76%	14.03%	0.00
Cotton	8.33%	0.10%	5.12%	4.64%	0.06
Gold	8.33%	-5.68%	2.06%	1.76%	0.11
Silver	8.33%	-8.09%	6.27%	5.09%	0.12
Copper	8.33%	6.17%	6.60%	4.99%	0.13
Equally Weighted Average Of The Individual Commodity Futures		-1.71%	6.94%	5.84%	0.09
Equally Weighted Portfolio		1.01%	1.01%	0.00%	
Diversification Return					
1) EW Portfolio Geometric Return - EW Average of Geometric Return		2.72%			
2) (EW Average Variance - EW Portfolio Variance)/2			2.97%		
3) Residual Variance/2				2.92%	
4) (1-1/N)* Average Variance *(1 - Average Correlation)/2					2.89%

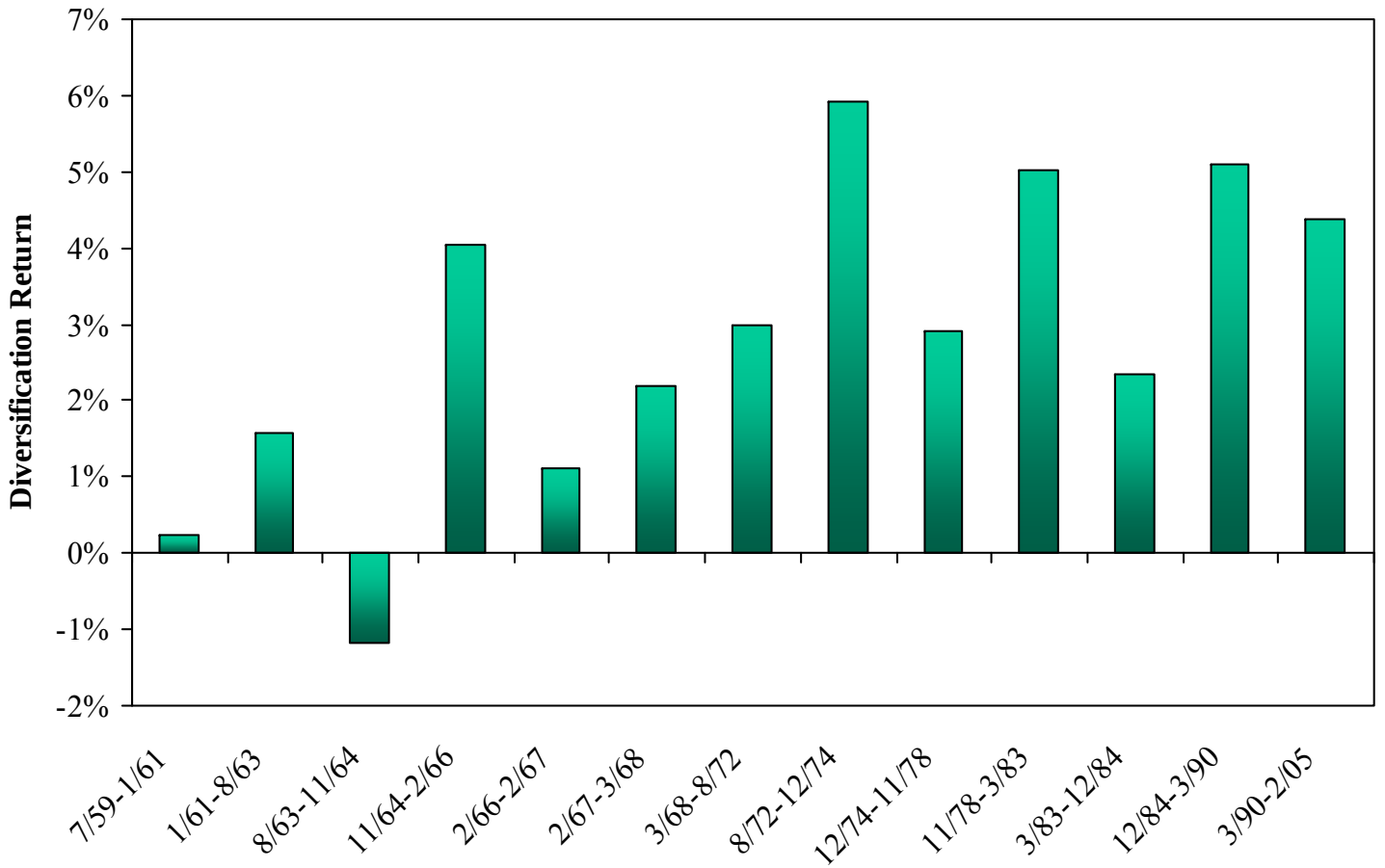
Asset Mix Changes and the Diversification Return

- The diversification return shows the benefit of mechanical portfolio rebalancing
- Easiest to calculate for a fixed universe of securities
  - The beginning number of securities has to equal the ending number of securities
- Say that the universe of securities consists of
  - Five securities for an initial period of five years, and
  - Ten securities for a subsequent period of five years
- In this example, when the size of the universe of securities varies over time
  - Calculate the five security diversification return for the first five years, then
  - Calculate the ten security diversification return for the next five years

Variation of the Diversification Return Over Time

July 1959 to February 2005

- In general, the diversification return has increased over time for an equally weighted portfolio of commodity futures

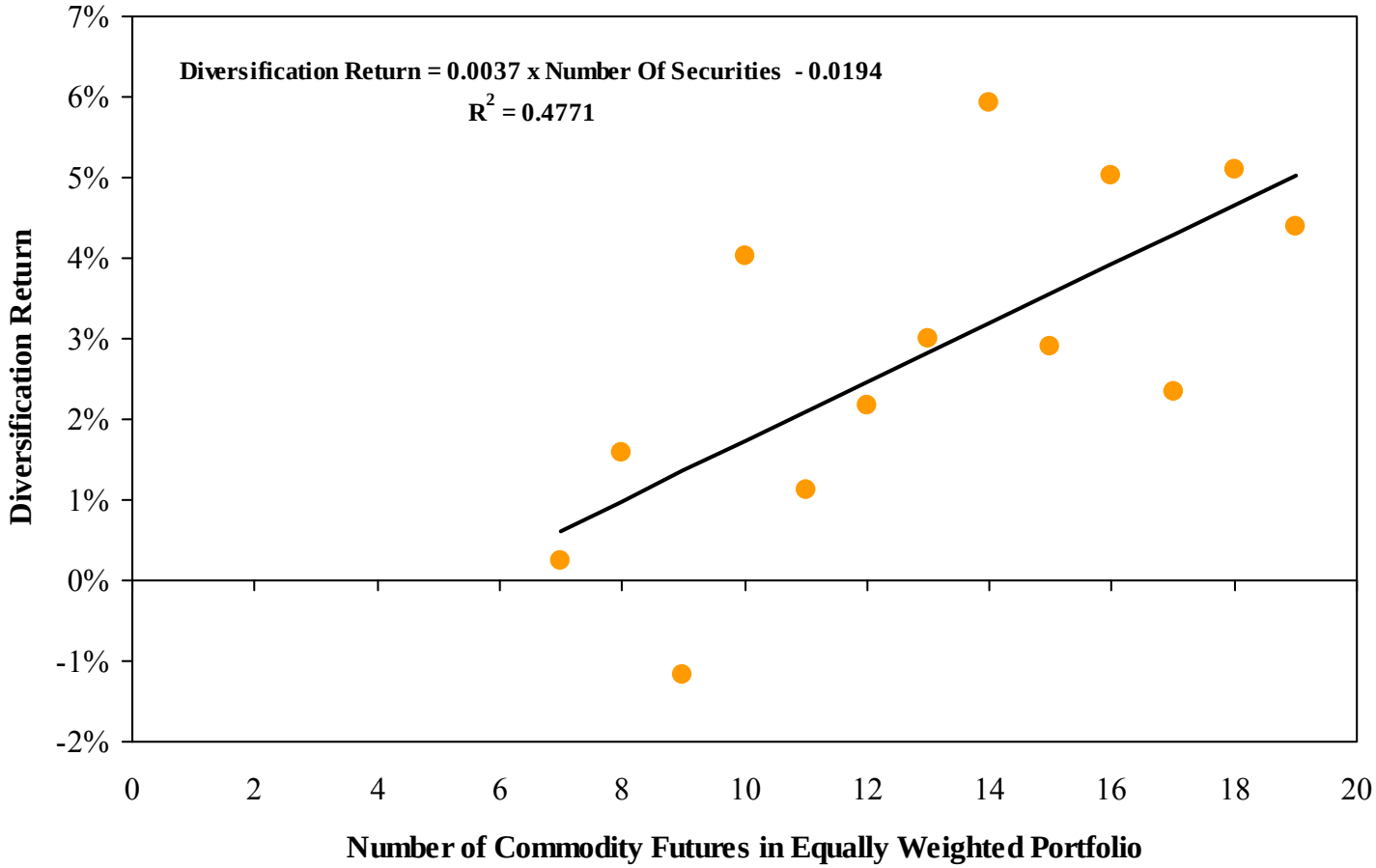


Note: Commodity Research Bureau data, www.crbtrader.com/crbindex/.
This is for a universe that starts with 7 contracts and ends with 19.

The Diversification Return and the Number of Investable Assets

July 1959 to February 2005

- In general, the diversification return increases with the number of assets
  - For an equally weighted portfolio of commodity futures

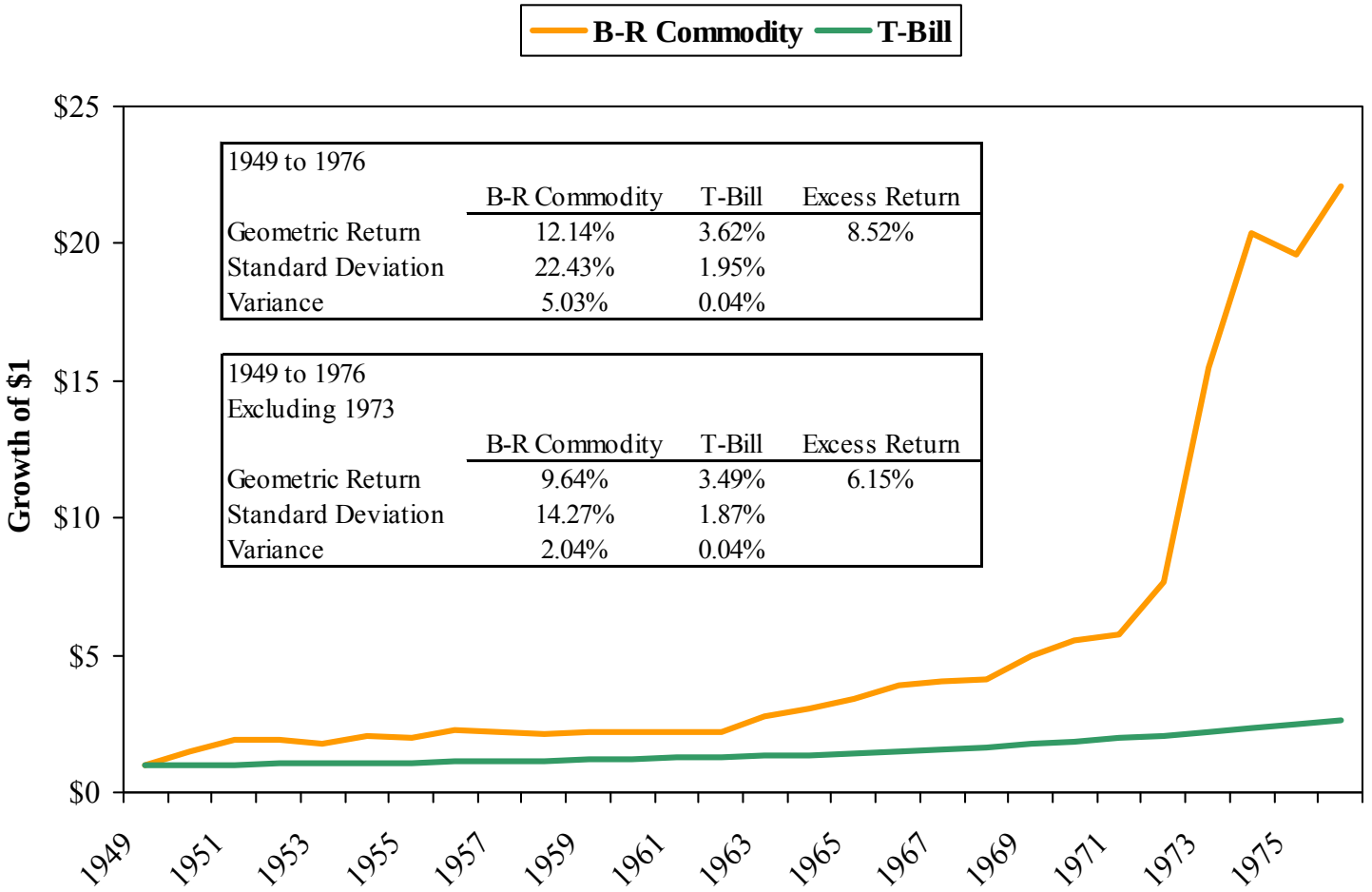


Note: Commodity Research Bureau data, www.crbtrader.com/crbindex/.
This is for a universe that starts with 7 contracts and ends with 19.

Classic Bodie and Rosansky Commodity Futures Portfolio

1949 to 1976

- Bodie and Rosansky looked at a universe of up to 23 commodity futures and calculated the return of an equally weighted portfolio
- How large was the diversification return in their study?



1949 to 1976	B-R Commodity	T-Bill	Excess Return
Geometric Return	12.14%	3.62%	8.52%
Standard Deviation	22.43%	1.95%	
Variance	5.03%	0.04%	

1949 to 1976 Excluding 1973	B-R Commodity	T-Bill	Excess Return
Geometric Return	9.64%	3.49%	6.15%
Standard Deviation	14.27%	1.87%	
Variance	2.04%	0.04%	

Note: Data from Zvi Bodie and Victor I. Rosanksy, "Risk and Return in Commodity Futures", *Financial Analysts Journal*, May-June 1980

Classic Bodie and Rosansky Commodity Futures Portfolio

1949 to 1976

- The Bodie and Rosansky rebalanced equally weighted commodity futures portfolio had a geometric excess return of 8.5% and a diversification return of 10.2%
- Bodie and Rosansky mistook a diversification return for a risk premium

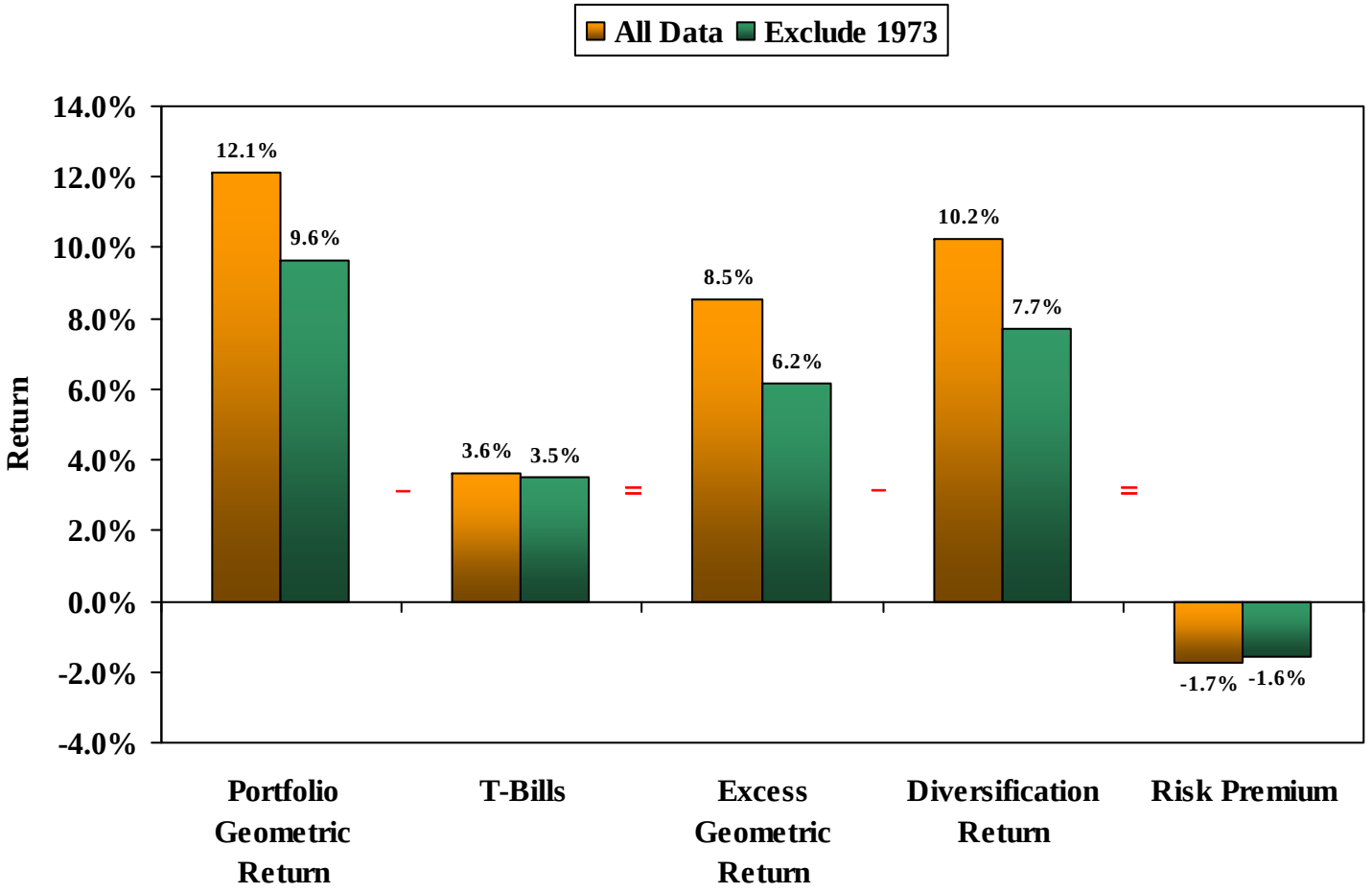
	Arithmetic Excess Return	Standard Deviation	Variance	Average Correlation	Number of Years
1 Wheat	3.18%	30.75%	9.45%	0.28	27
2 Corn	2.13%	26.31%	6.92%	0.34	27
3 Oats	1.68%	19.49%	3.80%	0.25	27
4 Soybeans	13.58%	32.32%	10.44%	0.28	27
5 Soybean Oil	25.84%	57.67%	33.26%	0.25	27
6 Soybean Meal	11.87%	35.60%	12.67%	0.20	27
7 Potatoes	6.91%	42.11%	17.73%	0.18	27
8 Wool	7.44%	36.96%	13.66%	0.19	27
9 Cotton	8.94%	36.24%	13.13%	0.20	27
10 Eggs	-4.74%	27.90%	7.78%	0.11	27
11 Cocoa	15.71%	54.63%	29.84%	0.06	23
12 Copper	19.79%	47.21%	22.28%	0.12	23
13 Sugar	25.40%	116.22%	135.06%	0.15	23
14 Silver	3.59%	25.62%	6.56%	0.23	13
15 Cattle	7.36%	21.61%	4.67%	0.17	12
16 Pork Bellies	16.10%	39.32%	15.46%	0.25	12
17 Platinum	0.64%	25.19%	6.34%	0.21	11
18 Orange Juice	2.51%	31.77%	10.09%	0.07	10
19 Hogs	13.28%	36.62%	13.41%	0.30	10
20 Broilers	13.07%	39.20%	15.37%	0.22	8
21 Propane	68.26%	202.09%	408.40%	0.07	8
22 Lumber	13.07%	34.67%	12.02%	0.19	7
23 Plywood	17.97%	39.96%	15.97%	0.17	6

Portfolio Geometric Retur	12.14%	
T-Bill Return	3.62%	
Excess Return	8.52%	
Diversification Return	**10.23%**	(Average Variance-Portfolio Varaince)/2
"Risk Premium"	-1.71%	

Note: Zvi Bodie and Victor Rosansky study covered 23 commodity futures over the period 1949 to 1976.

Classic Bodie and Rosansky Commodity Futures Portfolio

- Bodie and Rosanksy report the geometric total return of their portfolio
- However, investors are interested in a "risk premium"
- After accounting for the T-bill return and the diversification return
  - The "risk premium" is close to zero



Gorton and Rouwenhorst Commodities Futures Portfolio
1959 to 2004

- 20 years later, Gorton and Rouwenhorst (2005) consider another equally weighted portfolio
  - Had a geometric excess return of about 4% and a diversification return of about 4%

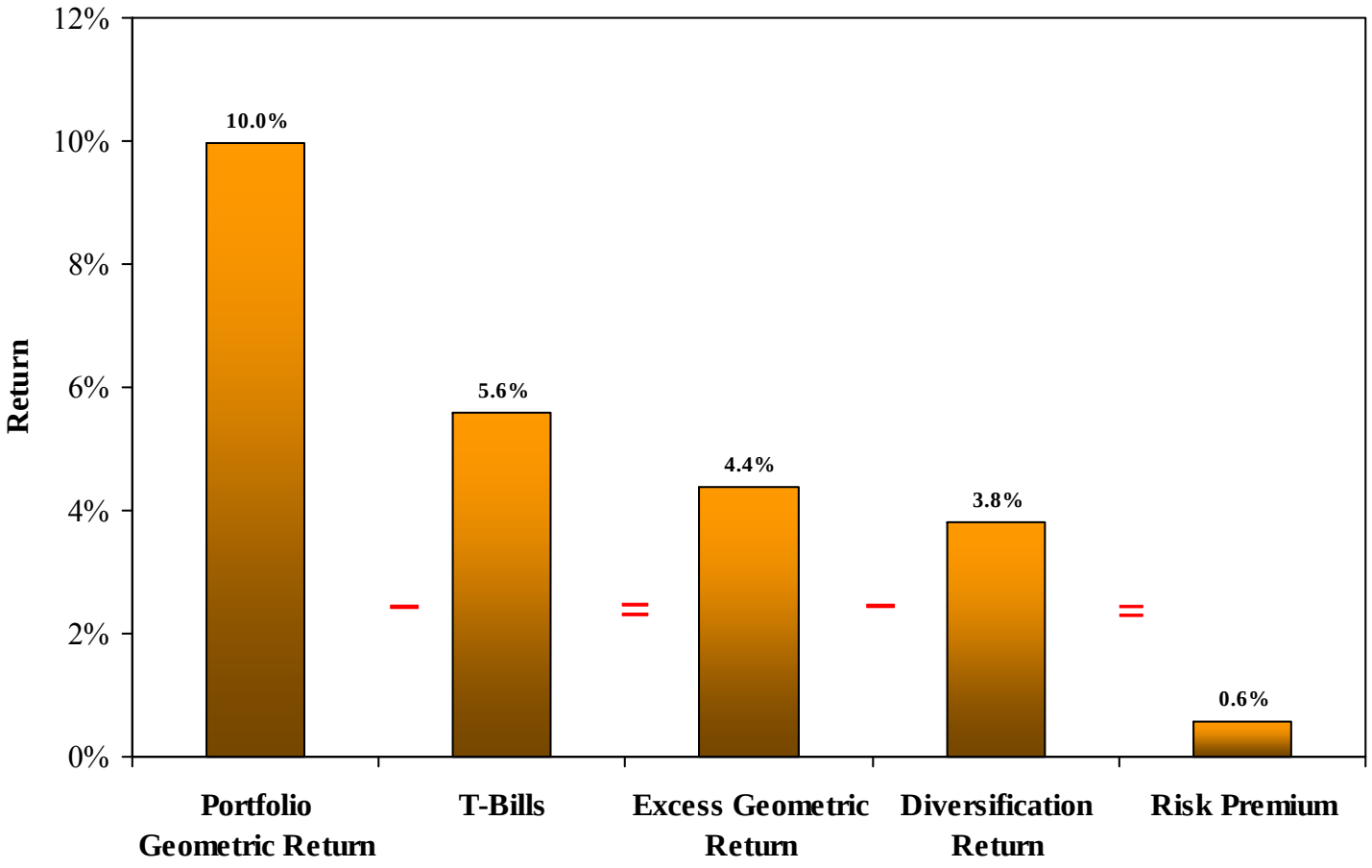
	Geometric Total Return	Geometric Excess Return	Standard Deviation	Variance	Average Correlation	Number of Months
1 Copper	12.16%	6.42%	27.04%	7.31%	0.15	546
2 Cotton	5.38%	-0.36%	23.27%	5.41%	0.05	546
3 Cocoa	4.18%	-1.56%	31.59%	9.98%	0.04	546
4 Wheat	0.74%	-5.00%	22.73%	5.17%	0.14	546
5 Corn	-1.90%	-7.64%	22.16%	4.91%	0.16	546
6 Soybeans	5.84%	0.10%	26.02%	6.77%	0.17	546
7 Soybean Oil	9.03%	3.29%	31.28%	9.78%	0.12	546
8 Soybean Meal	9.38%	3.64%	31.67%	10.03%	0.16	546
9 Oats	-1.22%	-6.96%	29.24%	8.55%	0.09	546
10 Sugar	2.12%	-3.71%	44.58%	19.87%	0.05	527
11 Pork Bellies	3.35%	-2.53%	35.98%	12.95%	0.10	519
12 Silver	2.83%	-3.19%	31.60%	9.99%	0.14	498
13 Live Cattle	11.39%	5.28%	17.96%	3.23%	0.10	481
14 Live Hogs	11.81%	5.64%	26.78%	7.17%	0.13	466
15 Orange Juice	6.30%	0.10%	32.76%	10.73%	-0.02	454
16 Platinum	6.06%	-0.19%	28.49%	8.12%	0.15	441
17 Lumber	1.91%	-4.35%	29.80%	8.88%	0.04	422
18 Feeder Cattle	7.90%	1.61%	17.17%	2.95%	0.07	397
19 Coffee	7.68%	1.33%	39.95%	15.96%	0.04	388
20 Gold	2.65%	-3.63%	19.34%	3.74%	0.13	360
21 Palladium	6.67%	0.33%	36.24%	13.13%	0.13	335
22 Zinc	5.99%	-0.35%	22.11%	4.89%	0.13	335
23 Lead	4.78%	-1.56%	22.74%	5.17%	0.13	334
24 Heating Oil	13.62%	7.28%	32.74%	10.72%	0.11	313
25 Nickel	10.51%	4.23%	36.83%	13.56%	0.10	308
26 Crude Oil	15.24%	9.98%	33.59%	11.28%	0.11	261
27 Unleaded Gas	18.73%	13.84%	34.49%	11.90%	0.11	240
28 Rough Rice	-5.59%	-10.27%	30.42%	9.25%	0.03	220
29 Aluminum	3.72%	-0.91%	24.07%	5.79%	0.10	210
30 Propane	20.61%	15.99%	49.40%	24.40%	0.08	208
31 Tin	0.91%	-3.38%	17.77%	3.16%	0.11	185
32 Natural Gas	1.70%	-2.40%	51.93%	26.97%	0.07	176
33 Milk	3.93%	0.25%	19.42%	3.77%	-0.01	107
34 Butter	17.06%	13.50%	40.06%	16.05%	0.01	99
35 Coal	-4.47%	-5.93%	22.01%	4.84%	0.16	41
36 Electricity	-54.56%	-55.77%	40.24%	16.19%	0.09	20

Portfolio Geometric Returr	9.98%	from Table 1, page 10, February 2005 version
T-Bill Return	5.60%	
Excess Return	4.38%	
Diversification Return	**3.82%**	(Average Varaince - Portfolio Variance)/2
Risk Premium	0.56%	

Note: Table data from February 2005 G&R paper, page 37

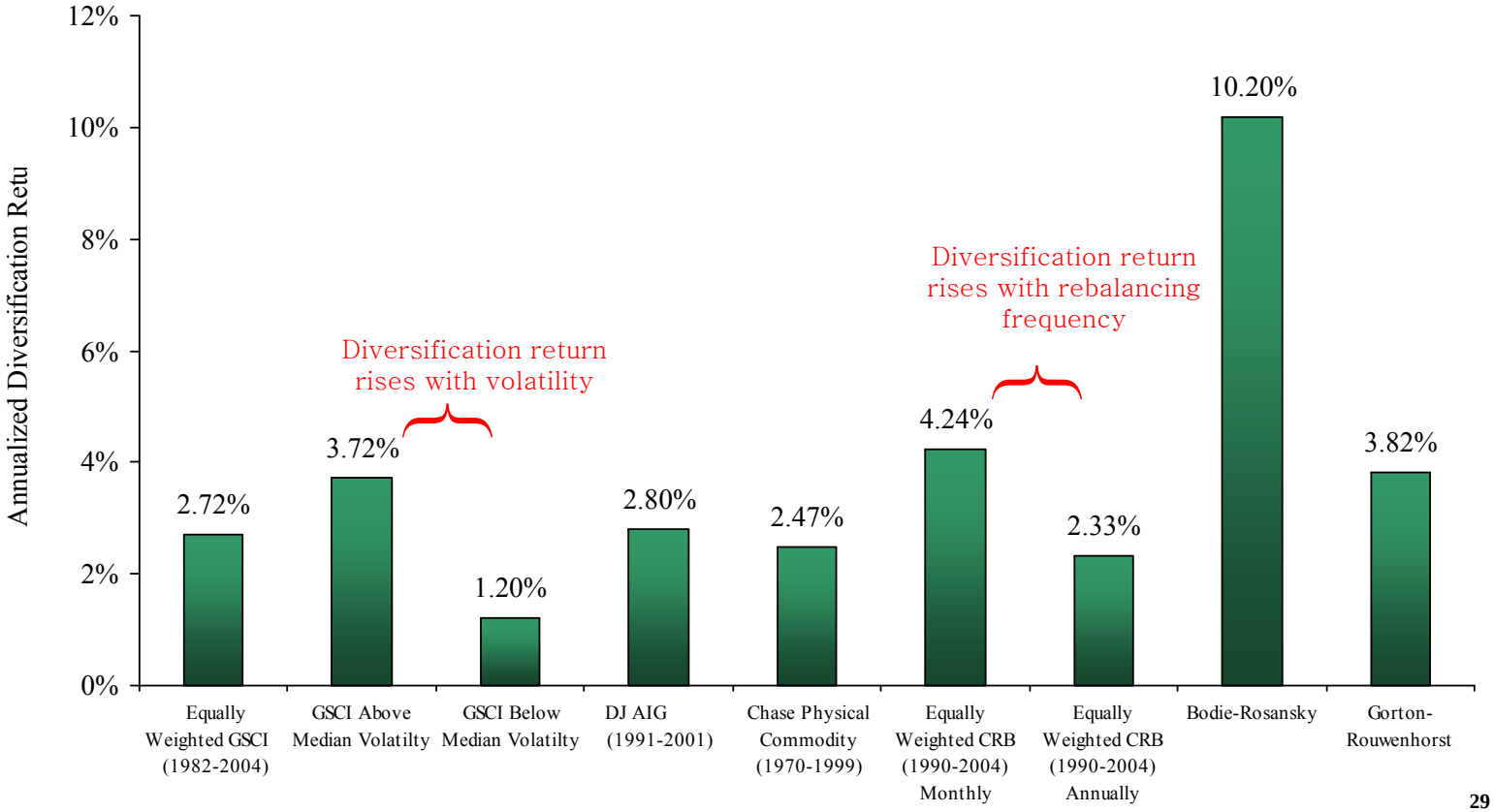
Gorton and Rouwenhorst Commodities Futures Portfolio
1959 to 2004

- After accounting for the T-bill return and the diversification return
  - The "risk premium" is close to zero



Factors that drive the diversification return

- A number of factors drive the size of the diversification return
  - Time period specific security correlations and variances
  - Number of assets in the investment universe
  - Rebalancing frequency
- The pay-off to a rebalancing strategy is not a risk premium



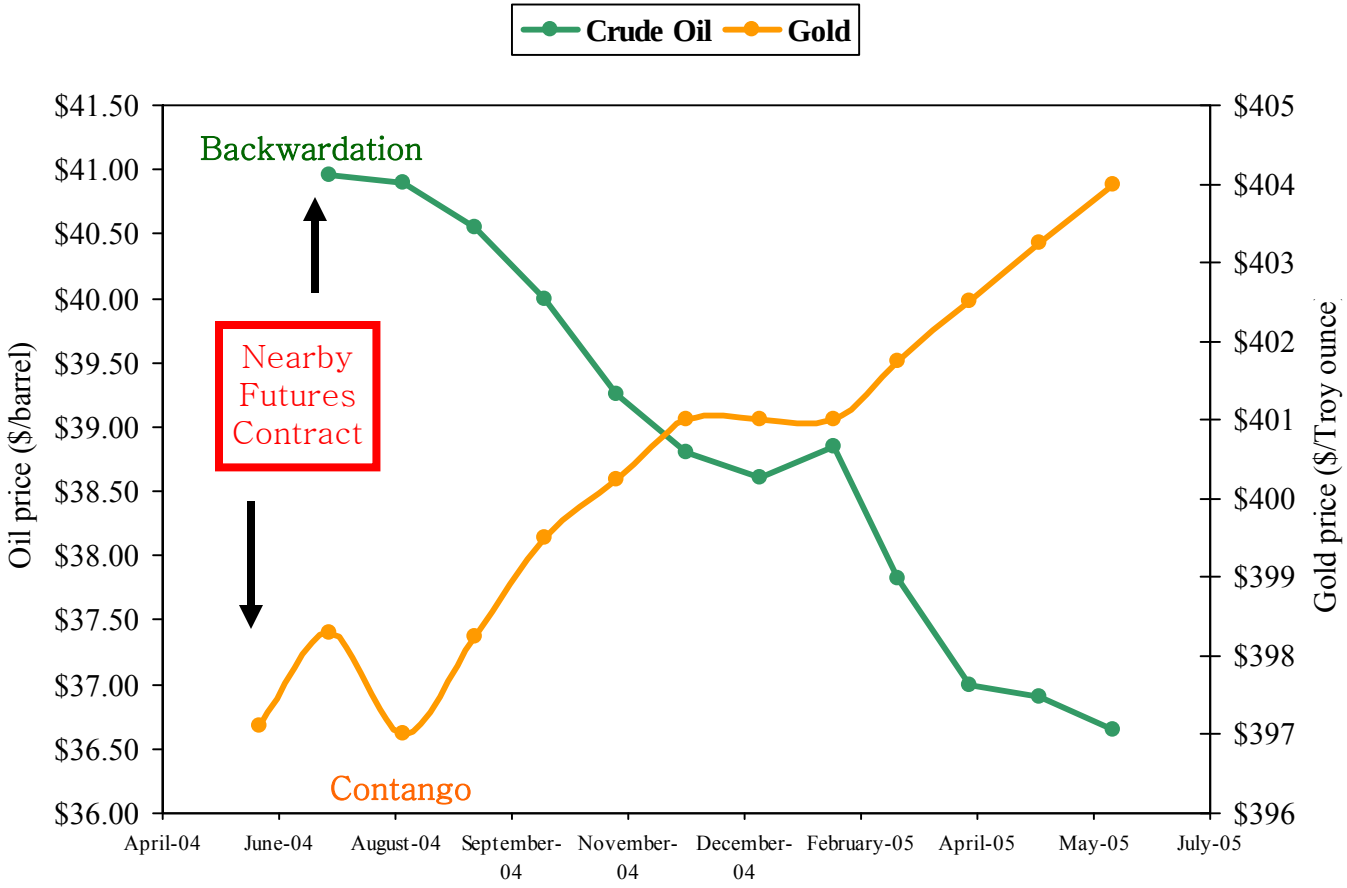
Erb-Harvey (2005)

The Components of Commodity Futures Excess Returns

- The excess return of a commodity futures contract has two components
  - Roll return and
  - Spot return
- The roll return comes from maintaining a commodity futures position
  - must sell an expiring futures contract and buy a yet to expire contract
- The spot return comes from the change in the price of the nearby futures contract
- The key driver of the roll return is the term structure of futures prices
  - Similar to the concept of "rolling down the yield curve"
- The key driver of the spot return might be something like inflation

What Drives Commodity Futures Returns?
The Term Structure of Commodity Prices

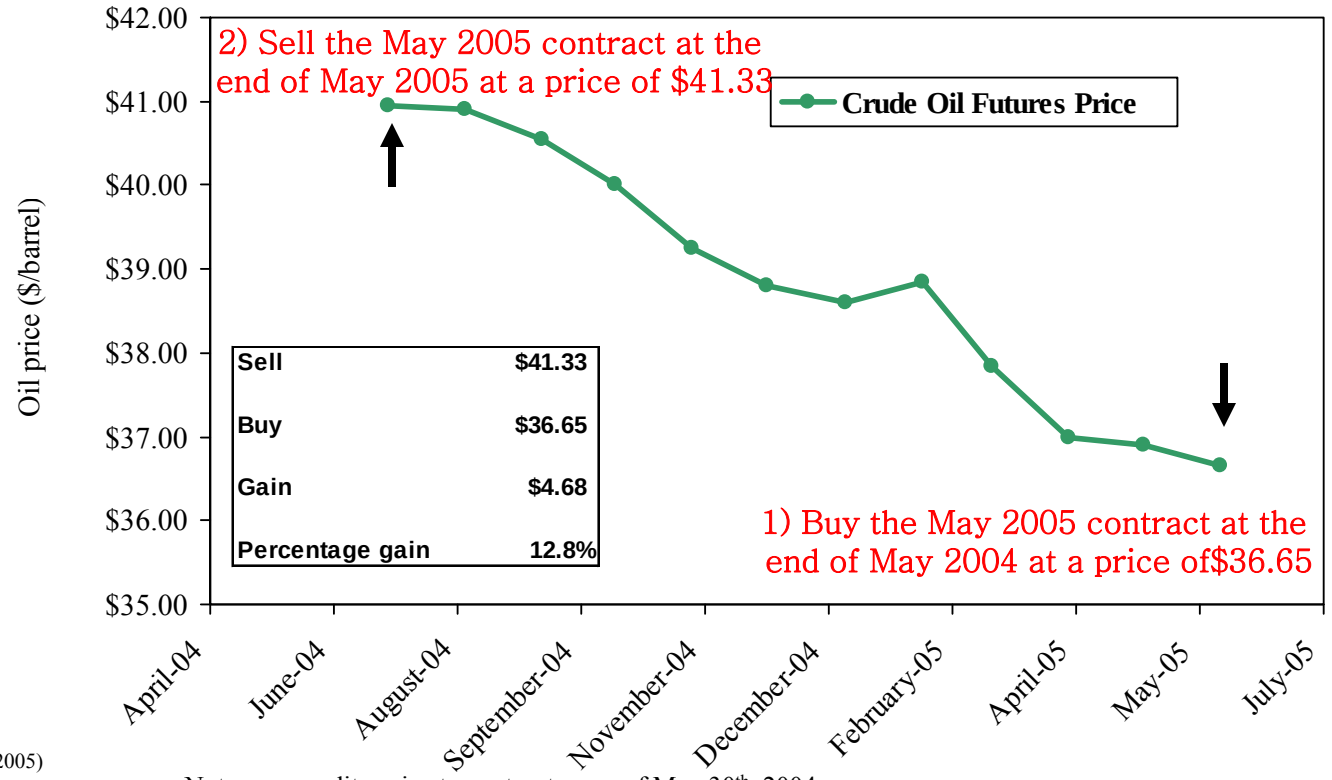
- Backwardation refers to futures prices that decline with time to maturity
- Contango refers to futures prices that rise with time to maturity



Note: commodity price term structure as of May 30th, 2004

What Drives Commodity Futures Returns?
The Roll Return and the Term Structure

- The term structure can produce a "roll return"
- The roll return is a return from the passage of time,
  - assuming the term structure does not change
- The greater the slope of the term structure, the greater the roll return



If the term structure remains unchanged between two dates, the roll return Is a passage of time return

Roll return should be positive if the term structure is downward sloping. Negative if upward sloping

Note: commodity price term structure as of May 30th, 2004

The 'Theory' of Normal Backwardation

- Normal backwardation is the most commonly accepted "driver" of commodity future returns

- "Normal backwardation" is a long-only risk premium "explanation" for futures returns
  - Keynes coined the term in 1923
  - It provides the justification for long-only commodity futures indices

- Keynes on Normal Backwardation

"If supply and demand are balanced, the spot price must exceed the forward price by the amount which the producer is ready to sacrifice in order to "hedge" himself, i.e., to avoid the risk of price fluctuations during his production period. Thus in normal conditions the spot price exceeds the forward price, i.e., there is a backwardation. In other words, the normal supply price on the spot includes remuneration for the risk of price fluctuations during the period of production, whilst the forward price excludes this."

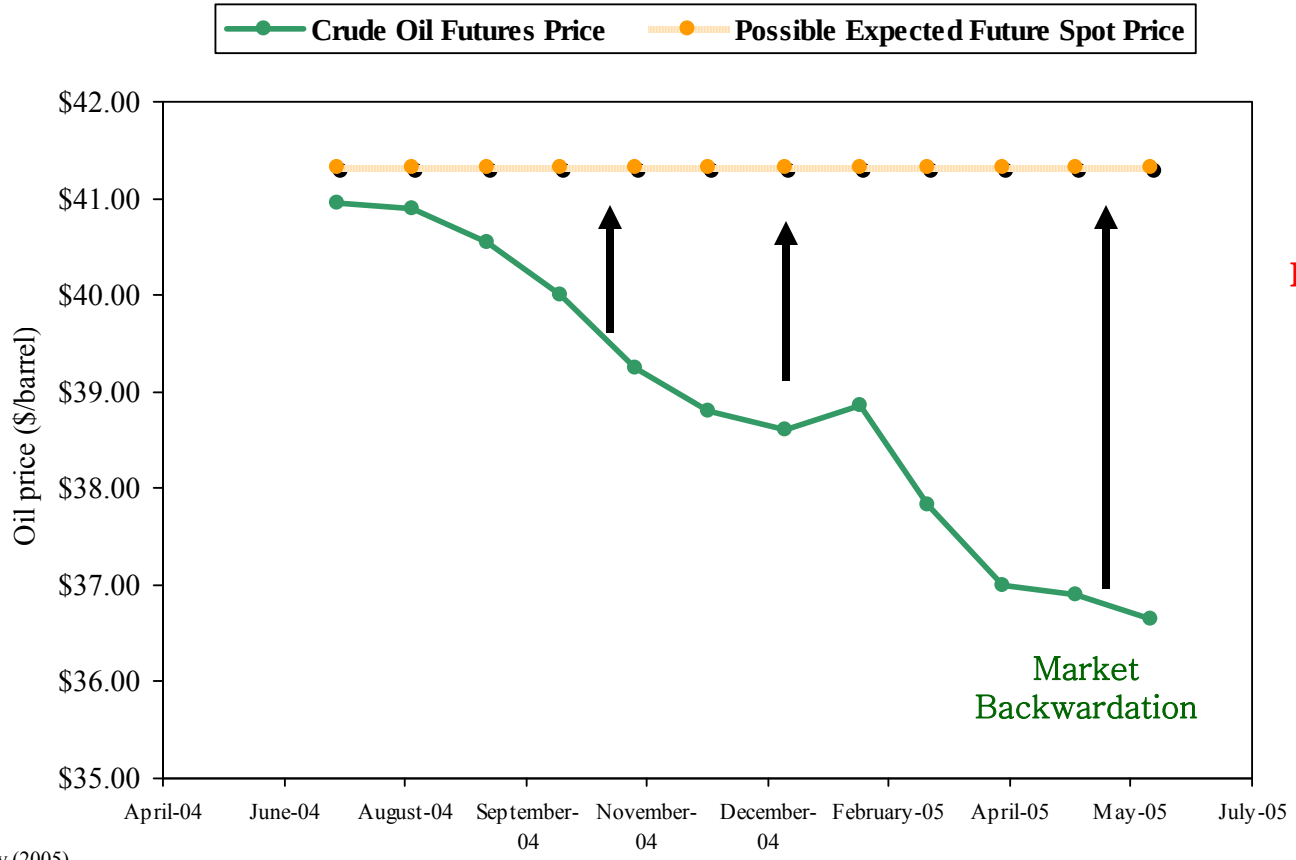
A Treatise on Money: Volume II, page 143

The 'Theory' of Normal Backwardation

- What normal backwardation says
  - Commodity futures provide "hedgers" with price insurance, risk transfer
  - "Hedgers" are net long commodities and net short futures
  - Futures trade at a discount to expected future spot prices
  - A long futures position should have a positive expected excess return
- How does normal backwardation tie into the term structure of commodity futures prices?
- What is the empirical evidence for normal backwardation and positive risk premia?

The 'Theory' of Normal Backwardation

- Normal backwardation says commodity futures prices are downward biased forecasts of expected future spot prices
- Unfortunately, expected future spot prices are unobservable. Nevertheless, the theory implies that commodity futures excess returns should be positive



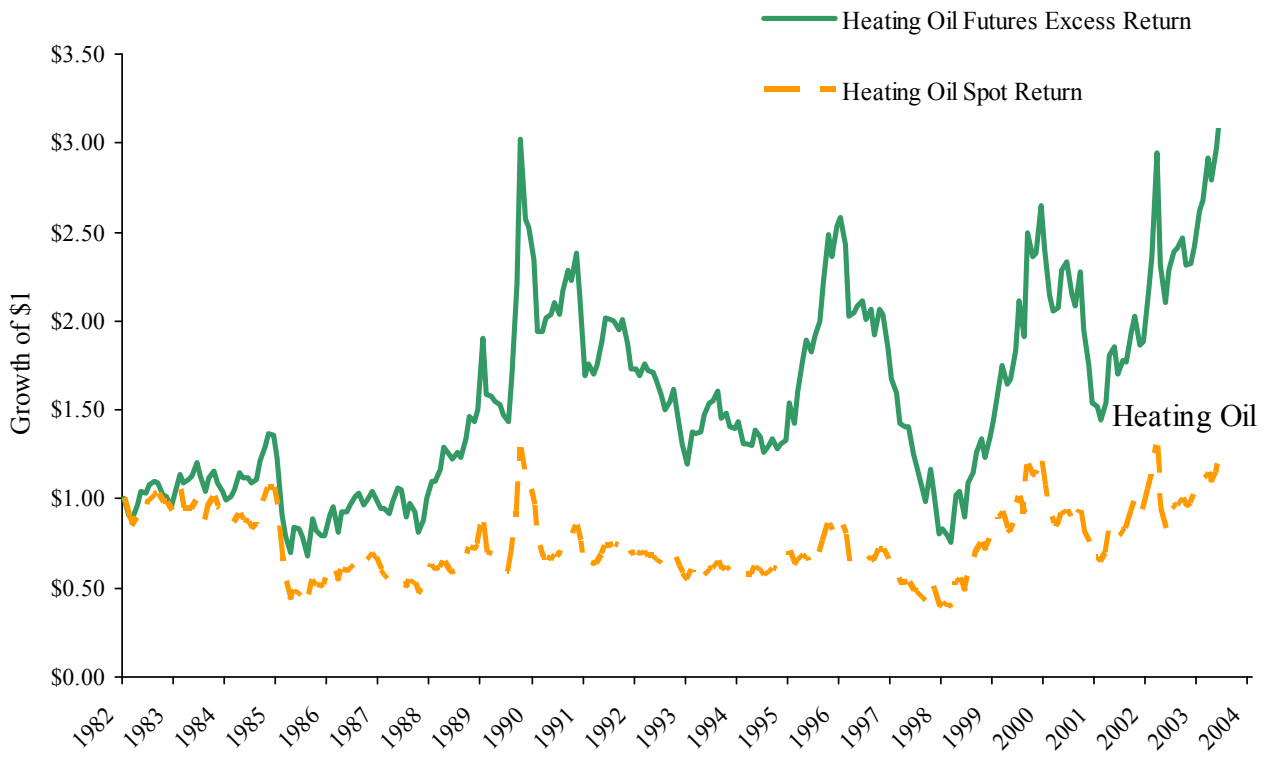
Normal Backwardation implies that futures prices converge to expected spot price

Erb-Harvey (2005)

Note: commodity price term structure as of May 30th, 2004

Evidence on Normal Backwardation

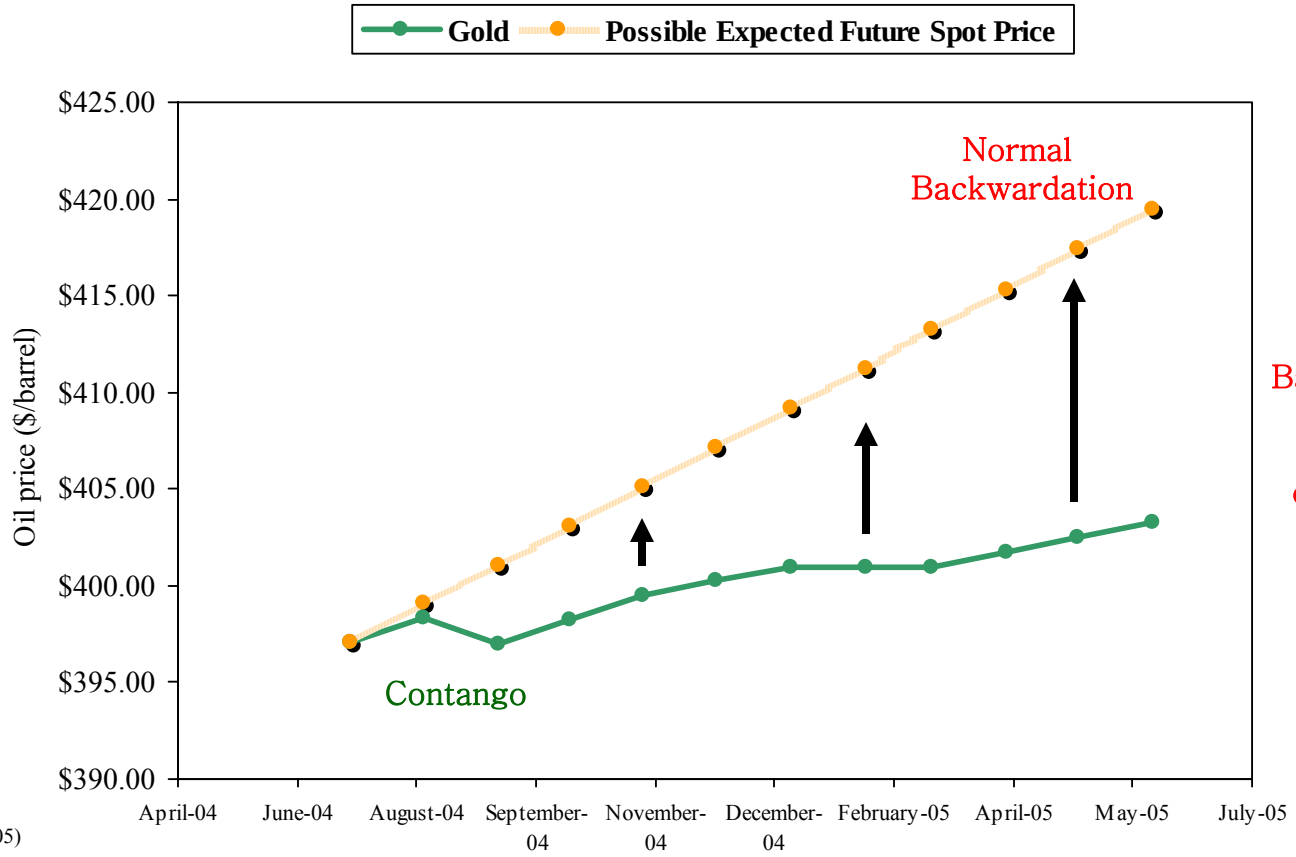
- Positive "energy" excess returns are often taken as "proof" of normal backwardation
- How robust is this "evidence"?



Excess Return	Spot Return	Roll Return
5.53%	0.93%	**4.60%**

Evidence on Normal Backwardation

- As we saw earlier, the gold term structure sloped upward
- Normal backwardation says
  - The excess return from gold futures should be positive
  - Expected future spot prices should be above the futures prices

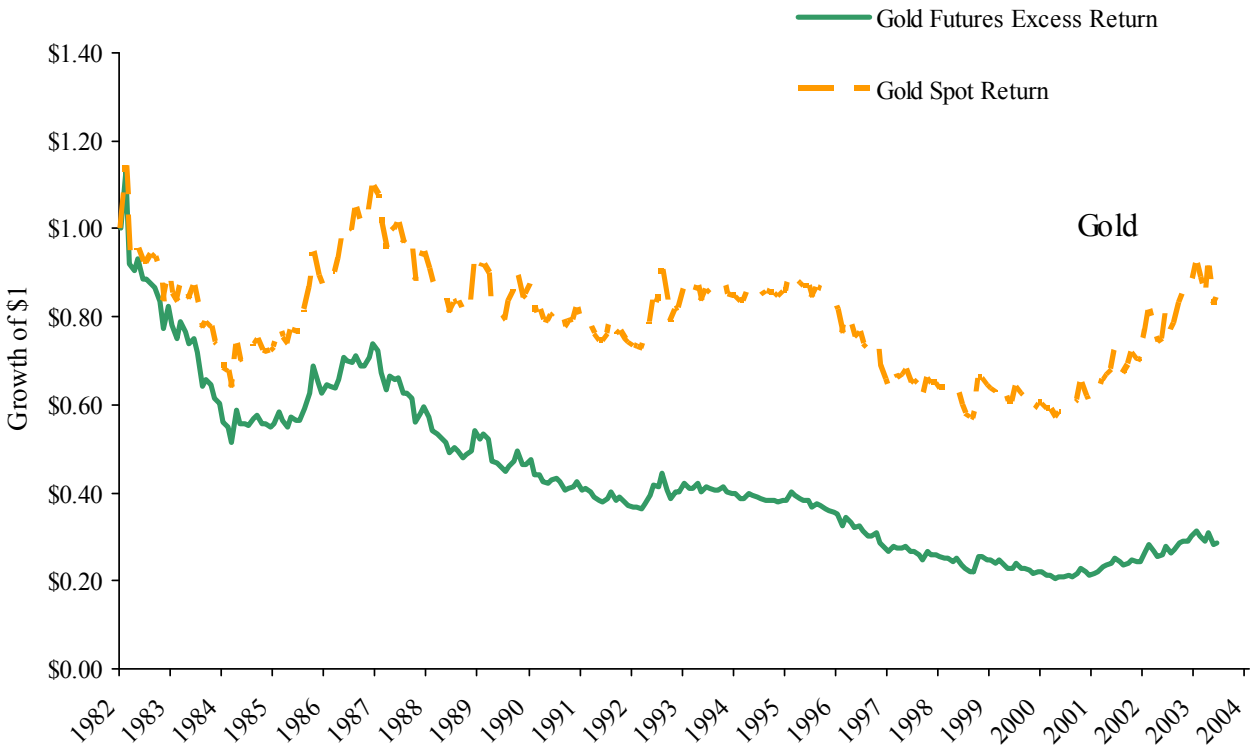


Normal Backwardation implies that futures prices converge to expected spot price

Note: commodity price term structure as of May 30th, 2004

Evidence on Normal Backwardation

- But gold futures excess returns have been negative

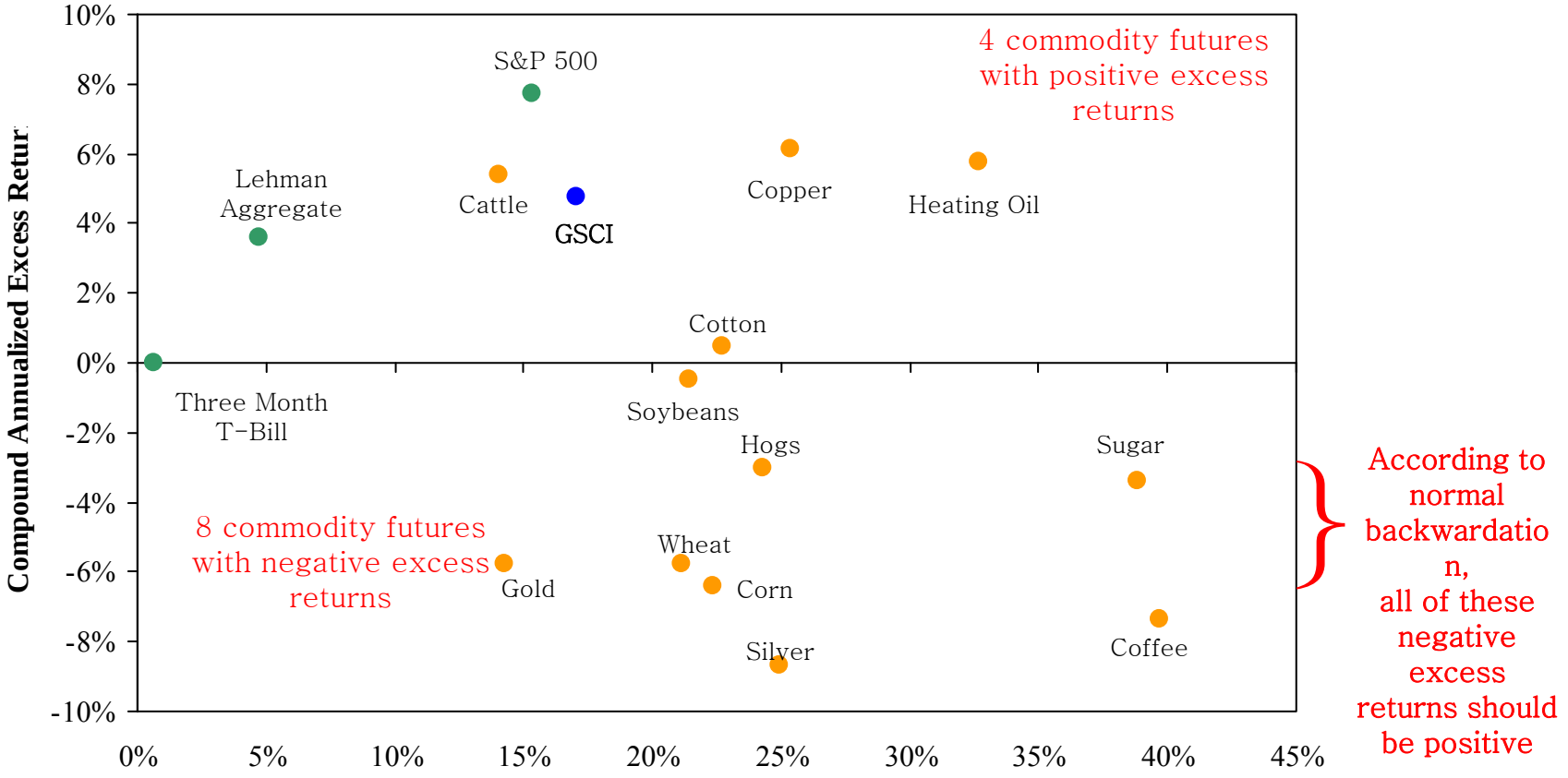


Excess Return	Spot Return	Roll Return
-5.68%	-0.79%	**-4.90%**

Evidence on Normal Backwardation

December 1982 to May 2004

- Normal backwardation asserts that commodity futures excess returns should be positive
- Historically, many commodity futures have had negative excess returns
  - This is not consistent with the prediction of normal backwardation
  - "Normal backwardation is not normal"*

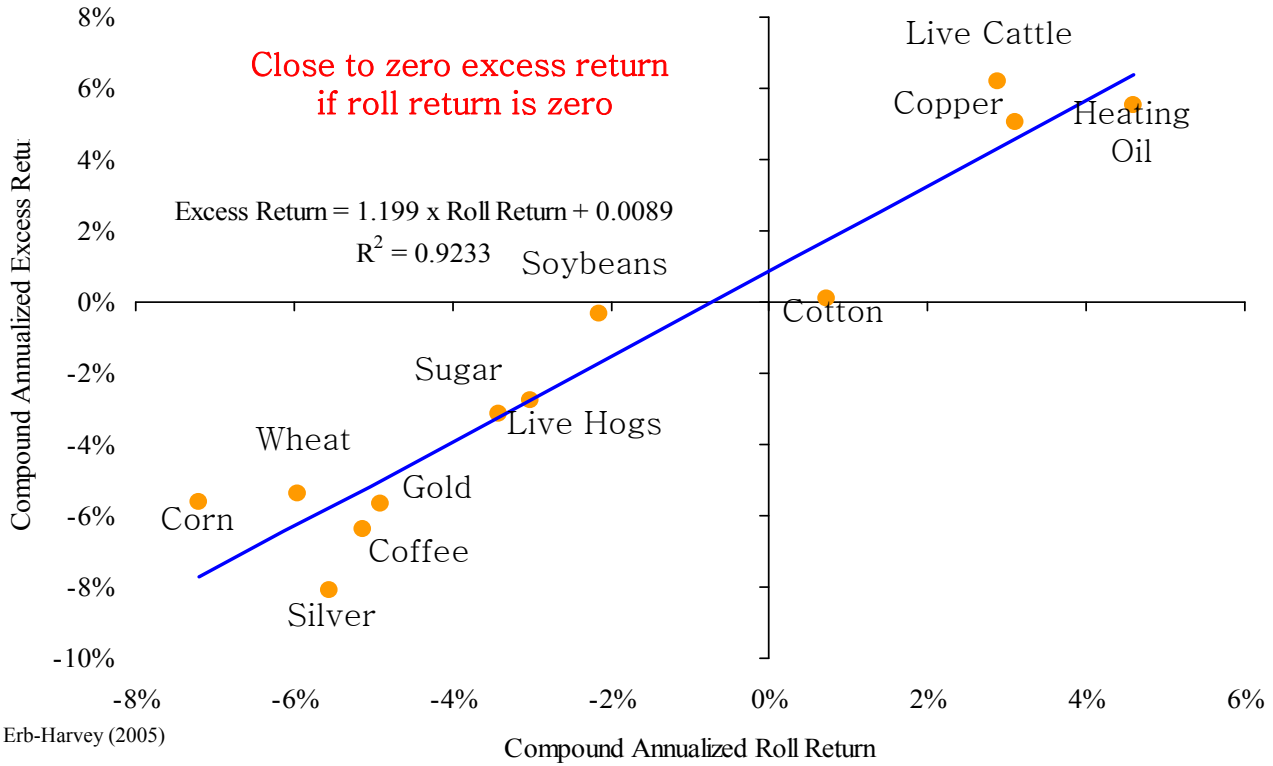


Erb-Harvey (2005)

* Robert W. Kolb, "Is Normal Backwardation Normal", Journal of Futures Markets, February 1

What Drives Commodity Futures Returns?
The Roll Return and the Term Structure (December 1982 to May 2004)

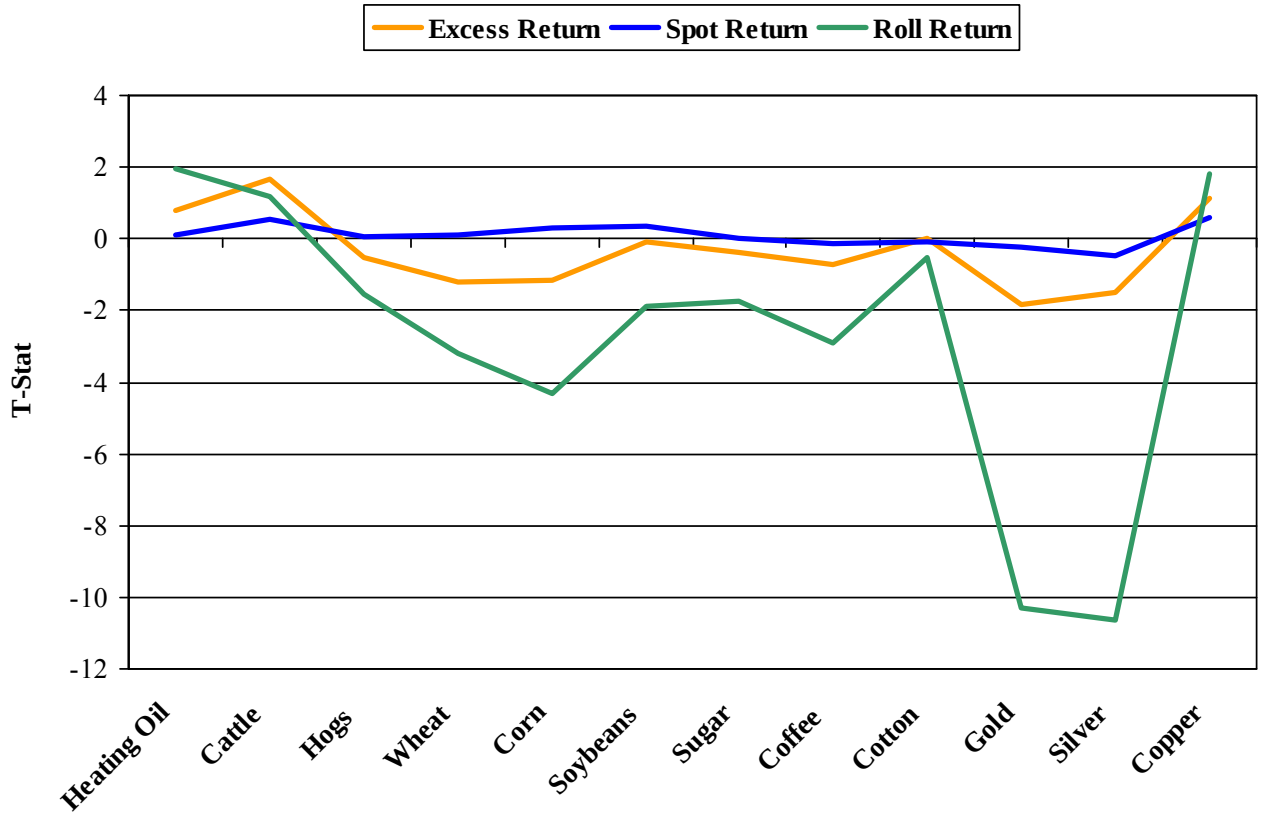
- A "visible" term structure drives roll returns, and roll returns have driven excess returns
- An "invisible" futures price/expected spot price "discount" drives normal backwardation
- What about spot returns?
  - Changes in the level of prices, have been relatively modest
  - Under what circumstances might spot returns be high or low?



Erb-Harvey (2005)

Return T-Statistics
December 1982 to May 2004

- Roll return t-stats have been much higher than excess return or spot return t-stats
  - Average absolute value of roll return t-stat: 3.5
  - Average absolute value of spot return t-stat: 0.25
  - Average absolute value of excess return t-stat: 0.91



What Drives Commodity Futures Returns? Pulling It All Together

- The excess return of a commodity future has two components

$$\text{Excess Return} = \text{Roll Return} + \text{Spot Return}$$

- If spot returns average zero, we are then left with a rule-of-thumb

$$\text{Excess Return} \sim \text{Roll Return}$$

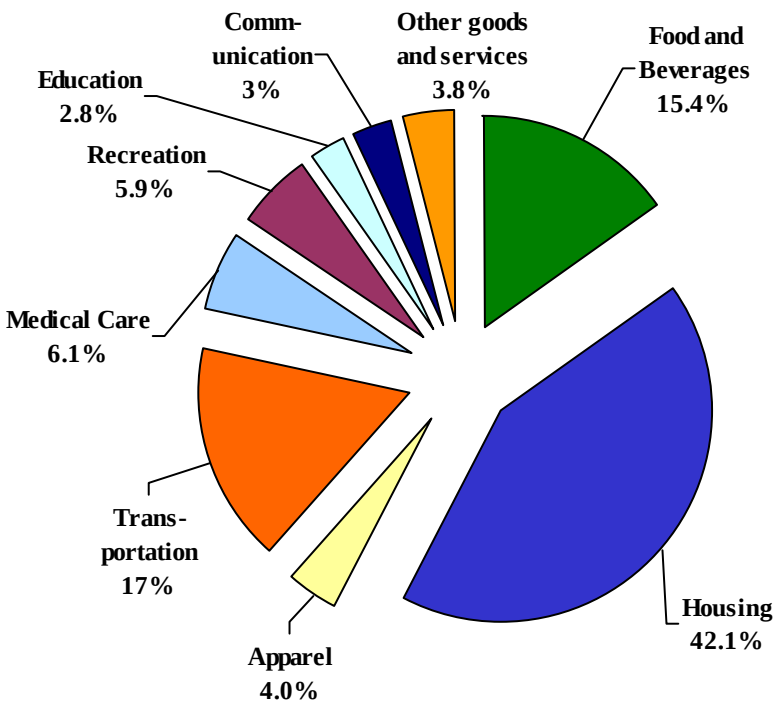
- The expected future excess return, then, is the expected future roll return

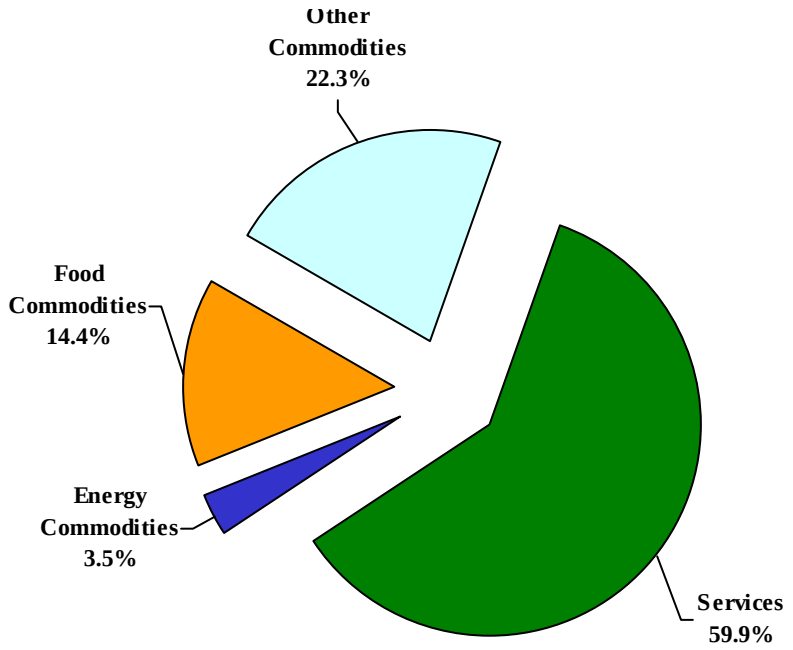
Are Commodity Futures an Inflation Hedge?

- What does the question mean?
  - Are “commodity futures” correlated with inflation?
  - Do all commodities futures have the same inflation sensitivity?
- Do commodity futures hedge unexpected or expected inflation?
- Are commodities an inflation hedge if the real price declines
  - Even though excess returns might be correlated with inflation?

Are Commodity Futures an Inflation Hedge?

- We will look at the correlation of commodity futures excess returns with the Consumer Price Index
- Yet the CPI is just a portfolio of price indices
  - The CPI correlation is just a weighted average of sub-component correlations



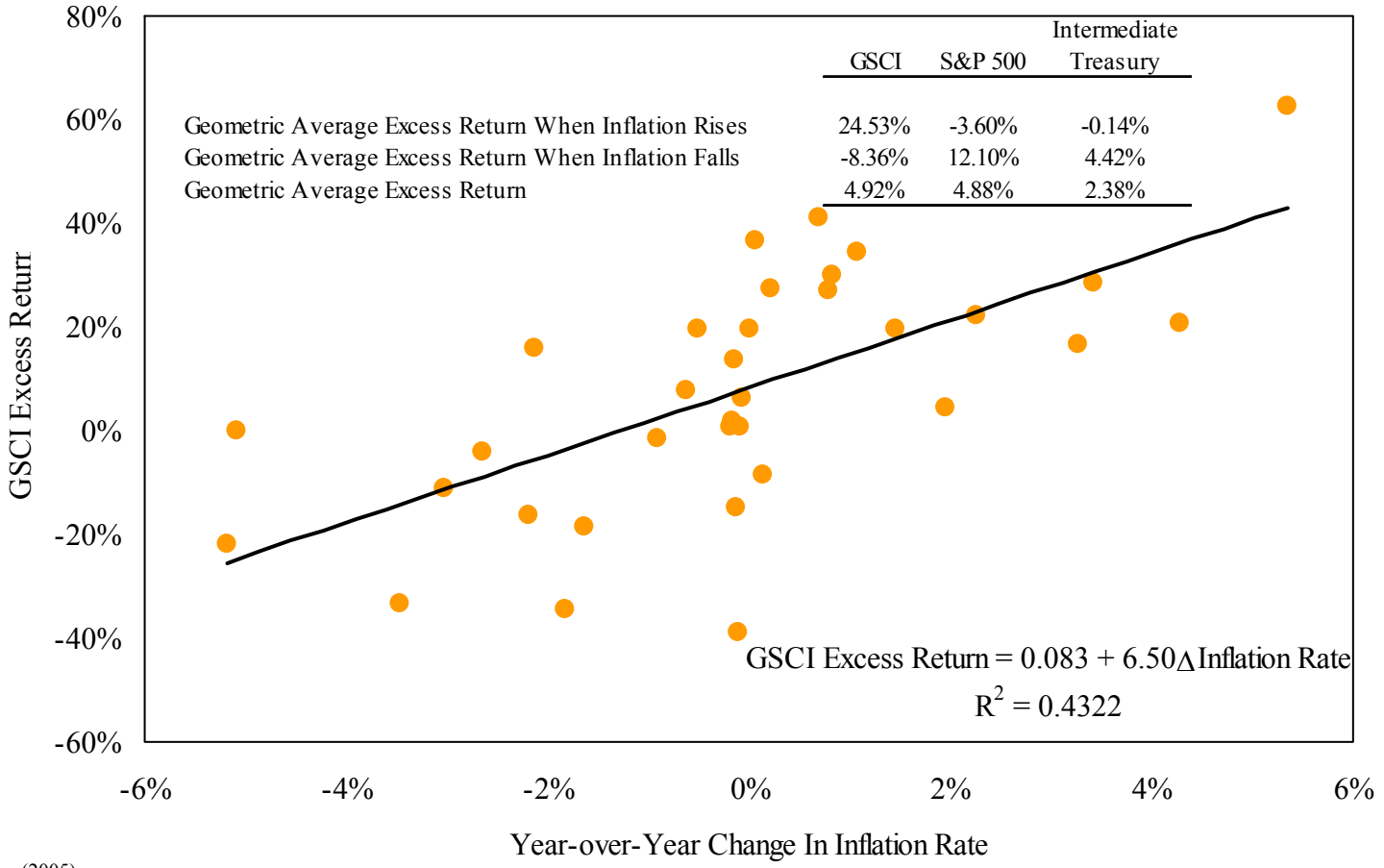


Note:

Expected or Unexpected Inflation Correlation?

1969 to 2003

- An inflation hedge should, therefore, be correlated with unexpected inflation
- Historically, the GSCI has been highly correlated with unexpected inflation
- However, the GSCI is just a portfolio of individual commodity futures
  - Do all commodity futures have the same unexpected inflation sensitivity?



Note: in this example the actual year-over-year change in the rate of inflation is the measure of unexpected inflation

Expected or Unexpected Inflation Correlation?

Annual Observations, 1982 to 2003

- Few commodity futures have had
  - A significant linkage to expected inflation, or
  - A significant linkage to unexpected inflation

	Intercept T-Stat	Inflation Coefficient	Inflation T-Stat	ΔInflation Coefficient	ΔInflation T-Stat	Adjusted R Square
GSCI	-0.38	3.92	0.93	10.88	**2.98**	28.0%
Non-Energy	-0.64	1.84	0.71	3.94	1.77	6.0%
Energy	-0.36	7.50	0.97	18.80	**2.81**	24.5%
Livestock	-1.15	4.73	1.49	6.88	**2.51**	17.6%
Agriculture	-0.67	1.68	0.48	1.06	0.35	-9.6%
Industrial Metals	0.26	1.20	0.15	17.44	**2.59**	26.7%
Precious Metals	2.36	-8.02	**-2.95**	-2.78	-1.19	26.2%
Heating Oil	-0.26	6.07	0.81	17.76	**2.73**	23.9%
Cattle	-0.75	4.00	1.38	7.19	**2.87**	24.0%
Hog	-1.23	6.32	1.24	6.47	1.48	2.0%
Wheat	-0.87	3.09	0.67	-2.58	-0.64	-0.1%
Corn	-1.37	5.91	1.15	4.44	1.00	-2.6%
Soybeans	1.17	-5.95	-1.11	-1.10	-0.24	-2.8%
Sugar	0.06	-0.06	-0.01	3.56	0.61	-7.7%
Coffee	0.11	-0.81	-0.07	0.24	0.02	-11.0%
Cotton	0.31	-0.51	-0.08	0.30	0.05	-11.0%
Gold	2.02	-7.50	**-2.58**	-2.38	-0.95	20.3%
Silver	2.16	-10.18	**-2.89**	-4.45	-1.46	24.3%
Copper	0.27	1.43	0.18	17.08	**2.45**	23.8%
EW 12 Commodities	0.14	0.15	0.06	3.88	1.74	10.3%

No R-Squared higher than 30%
That means the "tracking error" of commodity futures relative to inflation is close to the own standard deviation of each commodity future.

If the average commodity future own standard deviation is about 25%, it is hard to call this a good statistical hedge.

Annualized Excess Return and Inflation Changes

Annual Observations, 1982 to 2003

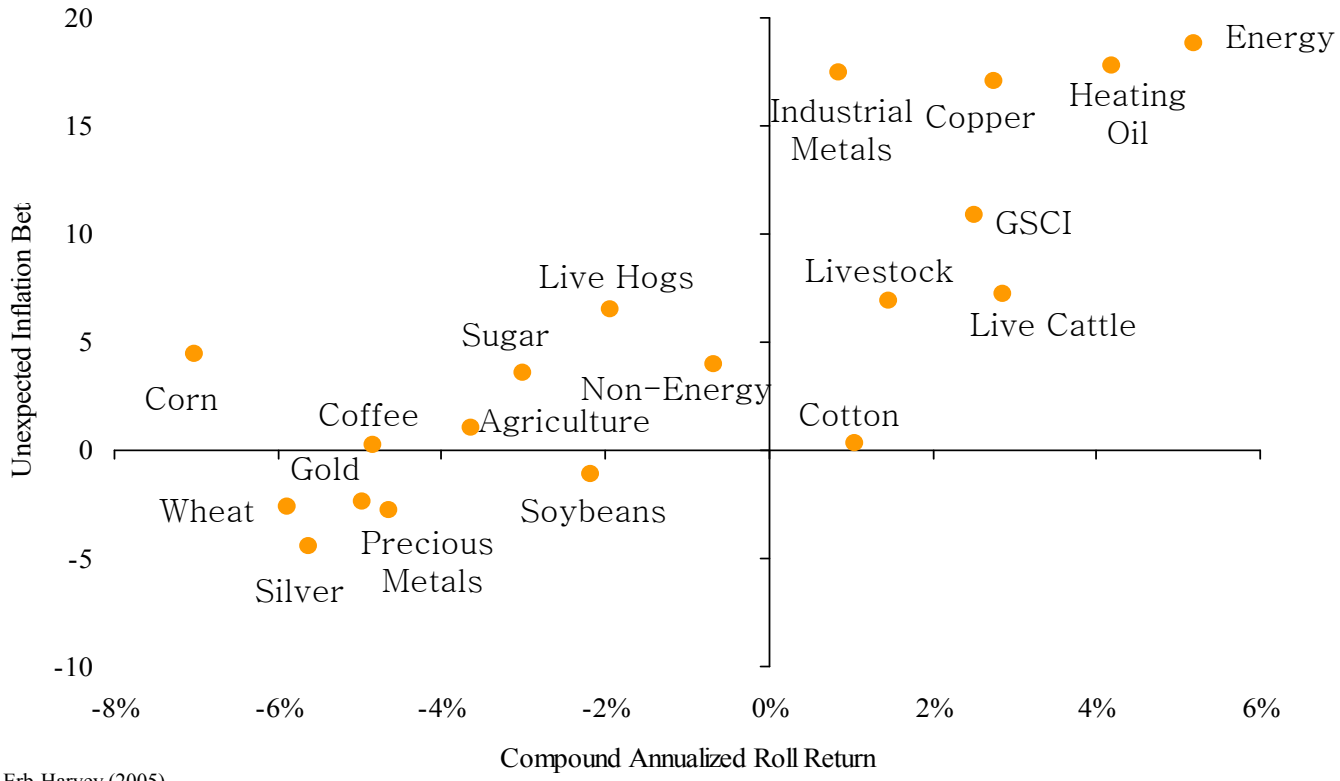
- A positive inflation beta does not necessarily mean commodity future's excess return is positive when inflation rises

	Excess Return			Roll Return		
	When Inflation Rises	When Inflation Falls	Difference	When Inflation Rises	When Inflation Falls	Difference
GSCI	22.2%	-8.2%	30.5%	6.6%	-0.3%	6.9%
Non-Energy	1.7%	-2.3%	4.0%	-0.8%	-0.8%	0.0%
Energy	41.0%	-14.2%	55.1%	14.7%	0.0%	14.7%
Livestock	8.8%	-3.9%	12.7%	0.9%	1.8%	-0.9%
Agriculture	**-5.7%**	-1.8%	-3.9%	-5.5%	-3.0%	-2.5%
Industrial Metals	15.2%	-4.3%	19.6%	9.3%	-4.1%	13.3%
Precious Metals	**-7.2%**	-3.6%	-3.5%	-5.0%	-4.2%	-0.9%
Heating Oil	36.9%	-14.4%	51.3%	10.1%	0.4%	9.6%
Cattle	10.8%	-0.9%	11.7%	2.9%	2.8%	0.1%
Hogs	5.5%	-10.2%	15.7%	-6.0%	-1.6%	-4.4%
Wheat	**-10.6%**	-1.1%	-9.5%	-8.8%	-5.3%	-3.5%
Corn	**-6.6%**	-7.3%	0.7%	-9.1%	-8.0%	-1.1%
Soybeans	**-3.7%**	1.8%	-5.5%	-3.6%	-1.9%	-1.7%
Sugar	**-2.7%**	-4.8%	2.2%	-1.4%	-6.6%	5.2%
Coffee	**-10.8%**	-6.0%	-4.8%	-5.7%	-3.8%	-1.9%
Cotton	1.8%	1.6%	0.2%	-4.8%	3.1%	-7.8%
Gold	**-7.1%**	-4.0%	-3.1%	-5.5%	-4.4%	-1.1%
Silver	**-13.8%**	-4.4%	-9.4%	-5.9%	-5.2%	-0.7%
Copper	15.3%	-2.6%	17.9%	10.2%	-1.8%	12.0%
Avg. Inflation Change	0.9%	-0.9%		0.9%	-0.9%	

Unexpected Inflation Betas and Roll Returns

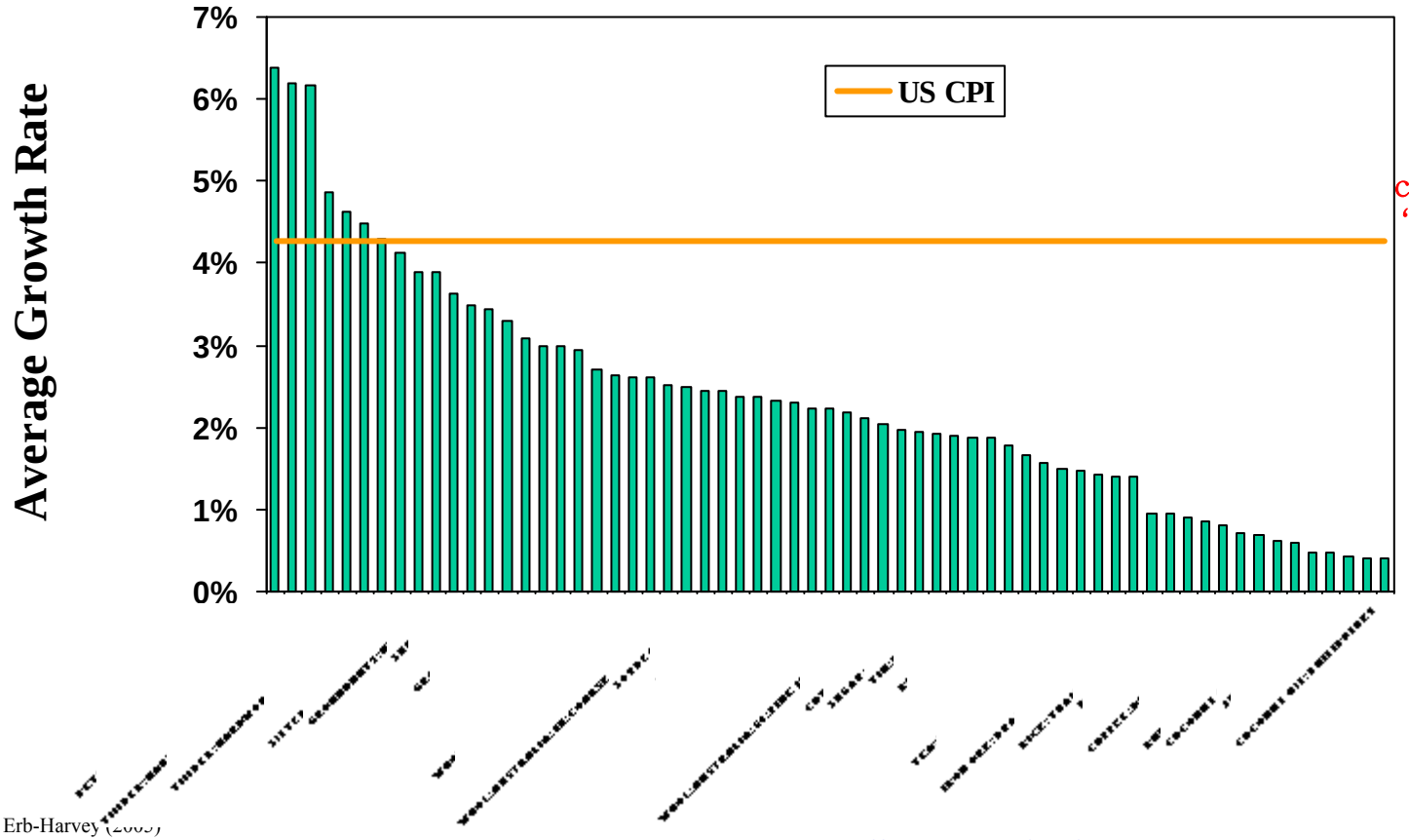
December 1982 to December 2003

- Commodity futures with the highest roll returns have had the highest unexpected inflation betas



Commodity Prices and Inflation
1959 to 2003

- The only long-term evidence is for commodity prices, not commodity futures
- In the long-run, the average commodity trails inflation



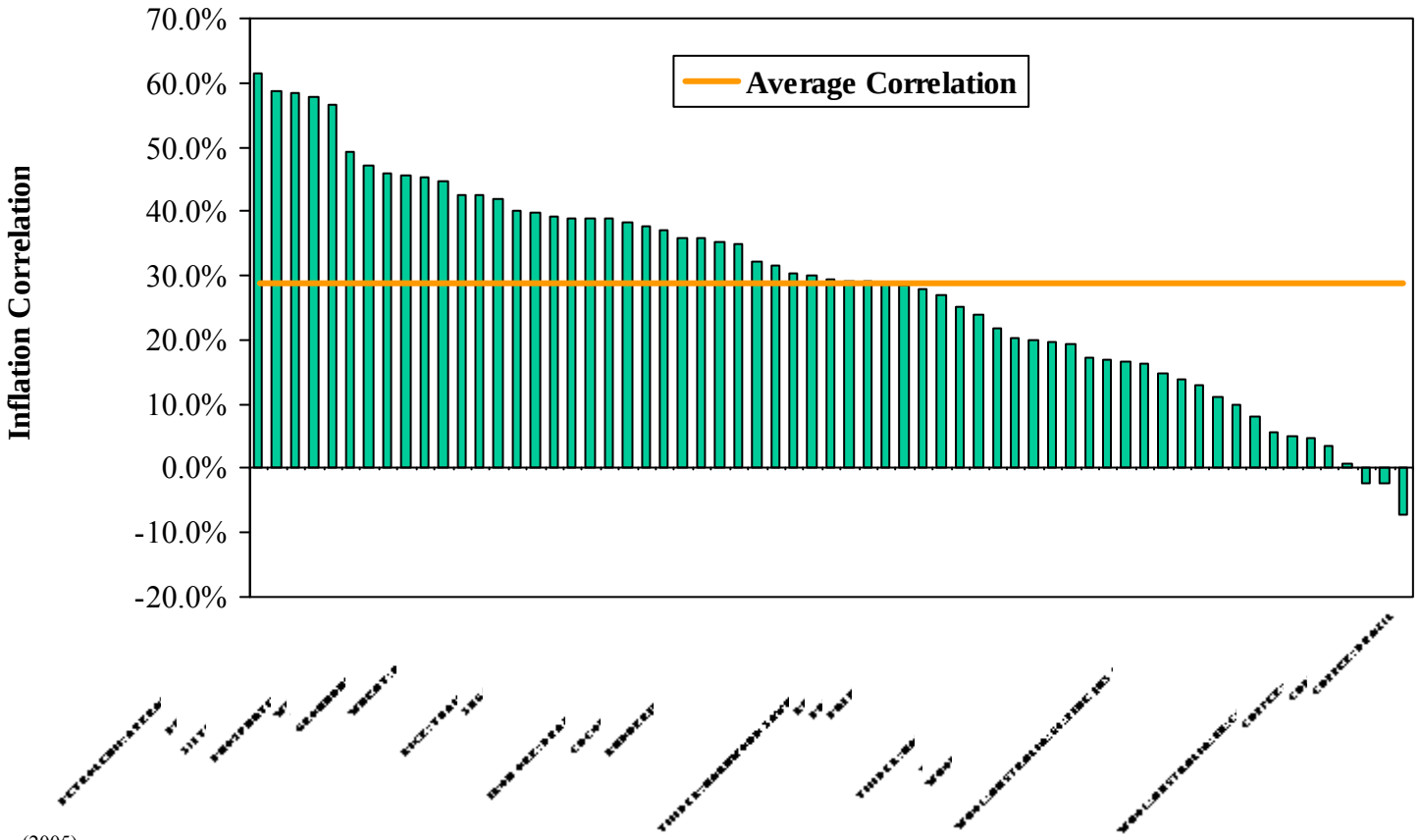
Go long "growth" commodities, and go short "no growth" commodities

Data source: International Financial Statstics, IMF, http://ifs.apdi.net/imf/logon.aspx

Correlation of Commodity Prices and Inflation

1959 to 2003

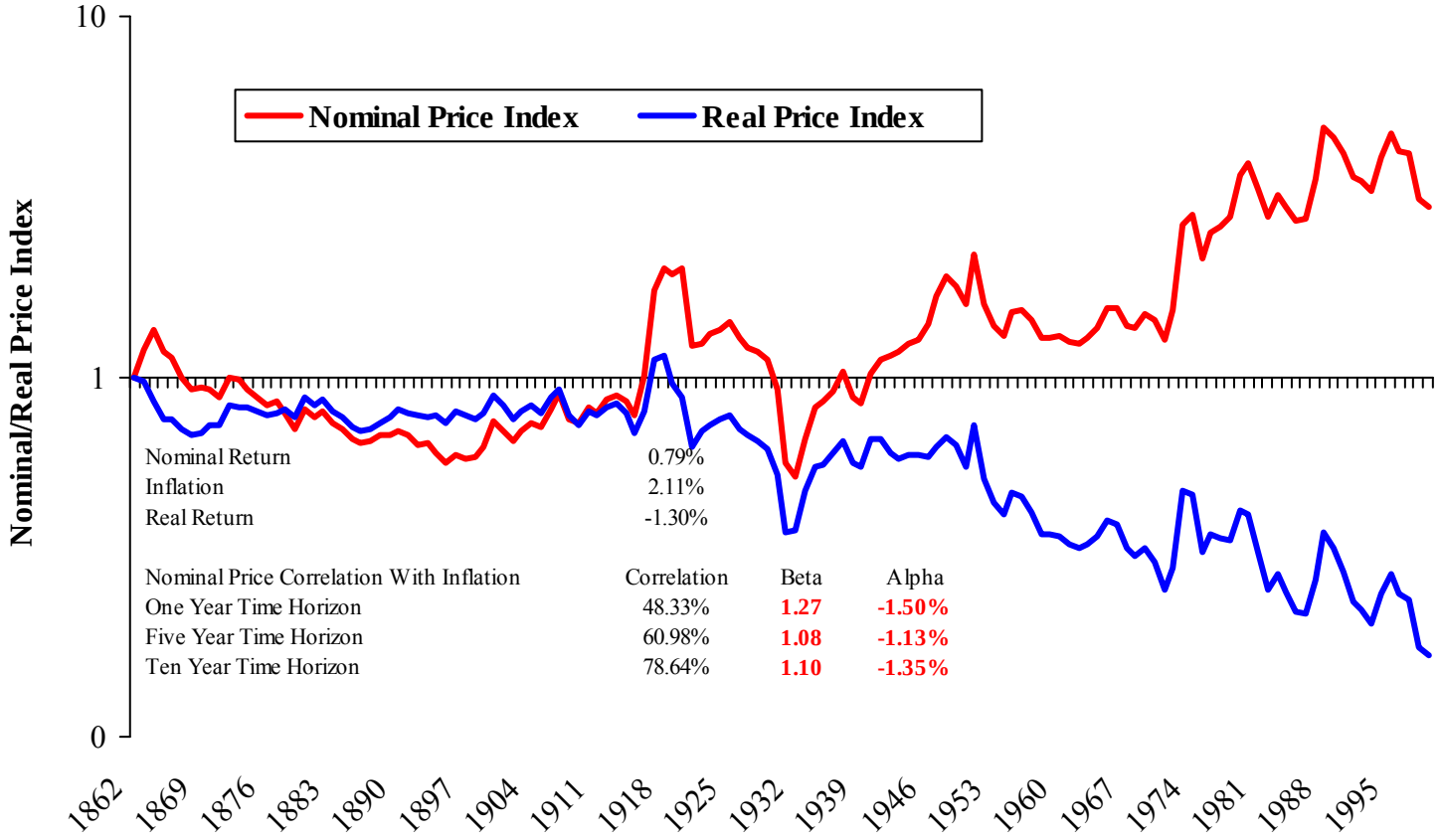
- The challenge for investors is that
  - Commodities might be correlated with inflation, to varying degrees, but
  - The longer-the time horizon the greater the expected real price decline



Data source: International Financial Statstics, IMF, http://ifs.apdi.net/imf/logon.aspx

The Economist Industrial Commodity Price Index
1862 to 1999

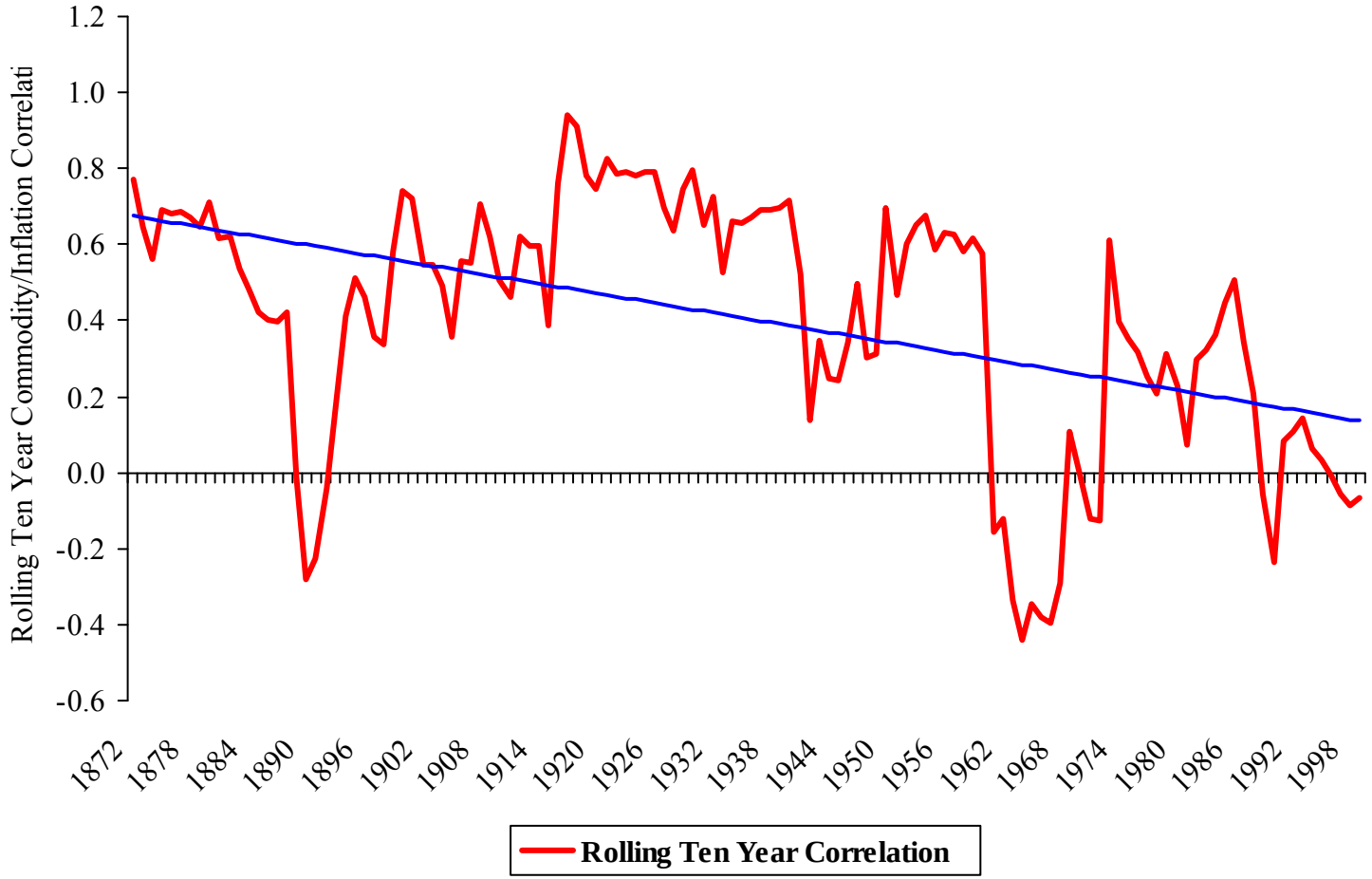
- Very long-term data shows that
  - Commodities have had a real annual price decline of 1% per year, and an "inflation beta" of about 1
- Short-run hedge and a long-run charity



Cashin, P. and McDermott, C.J. (2002), 'The Long-Run Behavior of Commodity Prices: Small Trends and Big Variability', IMF Staff Papers 49, 175-99.

The Economist Industrial Commodity Price Index
1862 to 1999

– The commodities-inflation correlation seems to have declined



Cashin, P. and McDermott, C.J. (2002), 'The Long-Run Behavior of Commodity Prices: Small Trends and Big Variability', IMF Staff Papers 49, 175-99.

Are Commodity Futures a Business-Cycle Hedge?

- Does a long-only commodity futures investment provide protection in recessions?
- Focus on the idea of commodity futures providing price insurance to hedgers
- Should the price of insurance vary with the business cycle?
  - Does the price of your homeowners insurance vary with the business cycle?
  - Does the price of your automobile insurance vary with the business cycle?
  - Does the price of life insurance vary with the business cycle?

Are Commodity Futures A Business Cycle Hedge?

- From December 1982 to May 2004
  - There were 17 recession months and 240 expansion months
- In this very short sample of history, commodity futures had poor recession returns

	Excess Return			Spot Return			Roll Return		
	Overall	Expansion	Contraction	Overall	Expansion	Contraction	Overall	Expansion	Contraction
GSCI	4.49%	5.93%	-13.87%	1.89%	3.48%	-18.11%	2.59%	2.45%	4.23%
Non-Energy	-0.12%	0.66%	-10.59%	0.67%	1.28%	-7.54%	-0.80%	-0.62%	-3.05%
Energy	7.06%	8.82%	-14.98%	1.69%	3.85%	-24.38%	5.37%	4.97%	9.40%
Livestock	2.45%	2.83%	-2.72%	1.20%	1.94%	-8.61%	1.25%	0.89%	5.88%
Agriculture	-3.13%	-2.02%	-17.54%	0.64%	1.08%	-5.43%	-3.77%	-3.10%	-12.11%
Industrial Metals	4.00%	5.34%	-13.10%	3.17%	4.76%	-16.92%	0.83%	0.57%	3.82%
Precious Metals	-5.42%	-5.06%	-10.38%	-0.84%	-0.36%	-7.31%	-4.58%	-4.69%	-3.07%
Heating Oil	5.53%	6.51%	-7.35%	0.93%	2.65%	-20.45%	4.60%	3.86%	13.10%
Cattle	5.07%	5.85%	-5.35%	1.97%	2.99%	-11.42%	3.10%	2.86%	6.07%
Hogs	-2.75%	-3.19%	3.78%	0.26%	0.60%	-4.45%	-3.01%	-3.80%	8.23%
Wheat	-5.39%	-4.44%	-17.85%	0.57%	0.41%	2.85%	-5.96%	-4.85%	-20.71%
Corn	-5.63%	-4.67%	-18.21%	1.57%	1.87%	-2.67%	-7.19%	-6.54%	-15.55%
Soybeans	-0.35%	0.35%	-9.76%	1.80%	2.36%	-5.79%	-2.15%	-2.01%	-3.96%
Sugar	-3.12%	-2.03%	-17.27%	0.30%	2.23%	-23.39%	-3.42%	-4.26%	6.12%
Coffee	-6.36%	-3.51%	-38.66%	-1.24%	0.40%	-21.65%	-5.12%	-3.91%	-17.02%
Cotton	0.10%	1.89%	-22.12%	-0.62%	0.25%	-12.14%	0.72%	1.65%	-9.98%
Gold	-5.68%	-5.72%	-5.15%	-0.79%	-0.71%	-1.92%	-4.90%	-5.01%	-3.23%
Silver	-8.09%	-6.82%	-24.29%	-2.54%	-1.23%	-19.26%	-5.55%	-5.59%	-5.03%
Copper	6.17%	7.73%	-13.57%	3.28%	5.02%	-18.44%	2.89%	2.70%	4.86%
Average	**-1.71%**	**-0.67%**	**-14.65%**	**0.46%**	**1.40%**	**-11.56%**	**-2.17%**	**-2.07%**	**-3.09%**

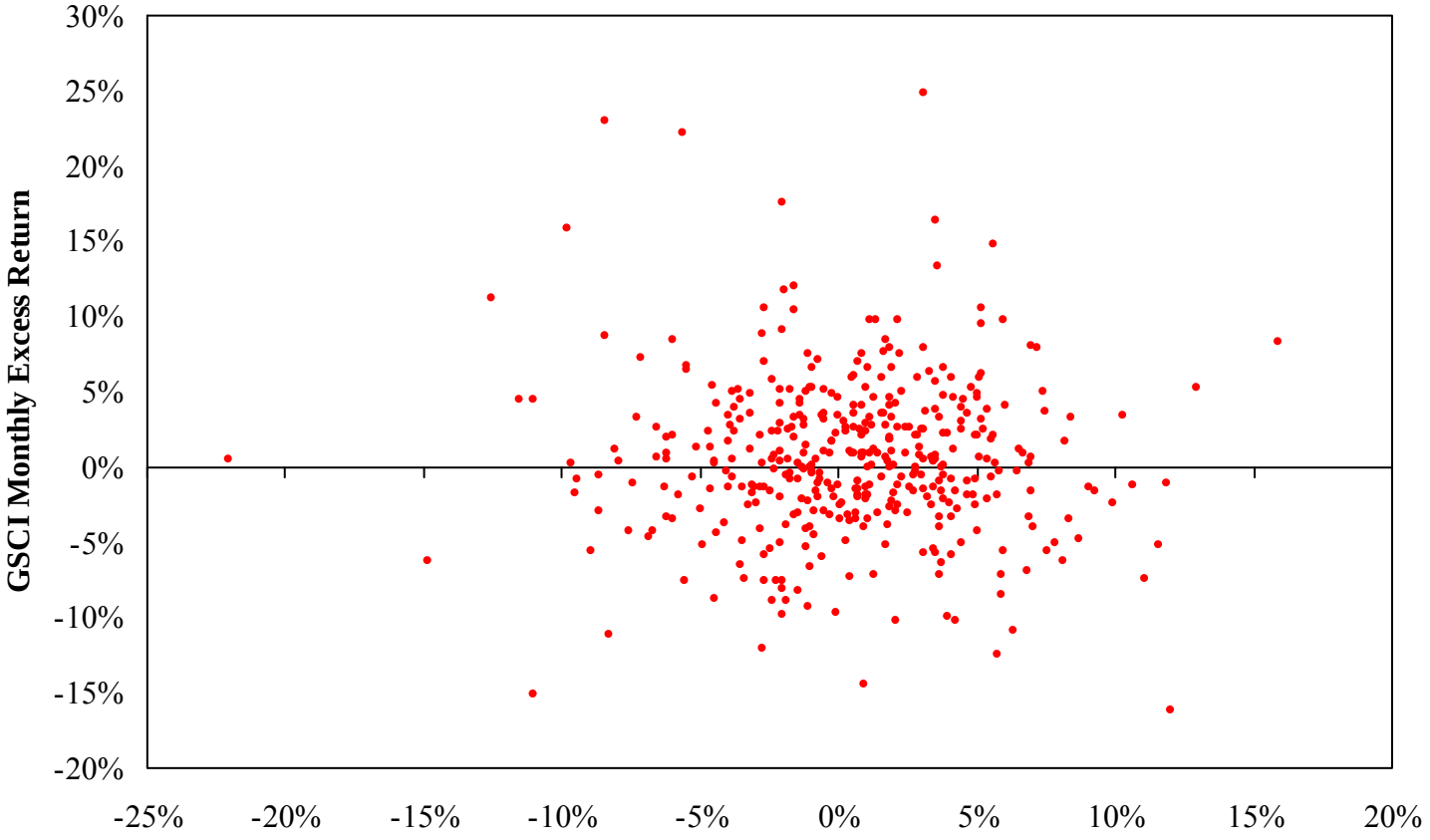
Erb-Harvey (2005)

GSCI As An Equity Hedge?
December 1969 to May 2004

- No evidence that commodity futures are an equity hedge
- Returns largely uncorrelated

Frequency of Monthly Excess Return Observations

	S&P 500 Excess Return>0	S&P 500 Excess Return<0
GSCIExcess Return>0	**31.23%**	23.49%
GSCI Excess Return<0	24.46%	**20.82%**



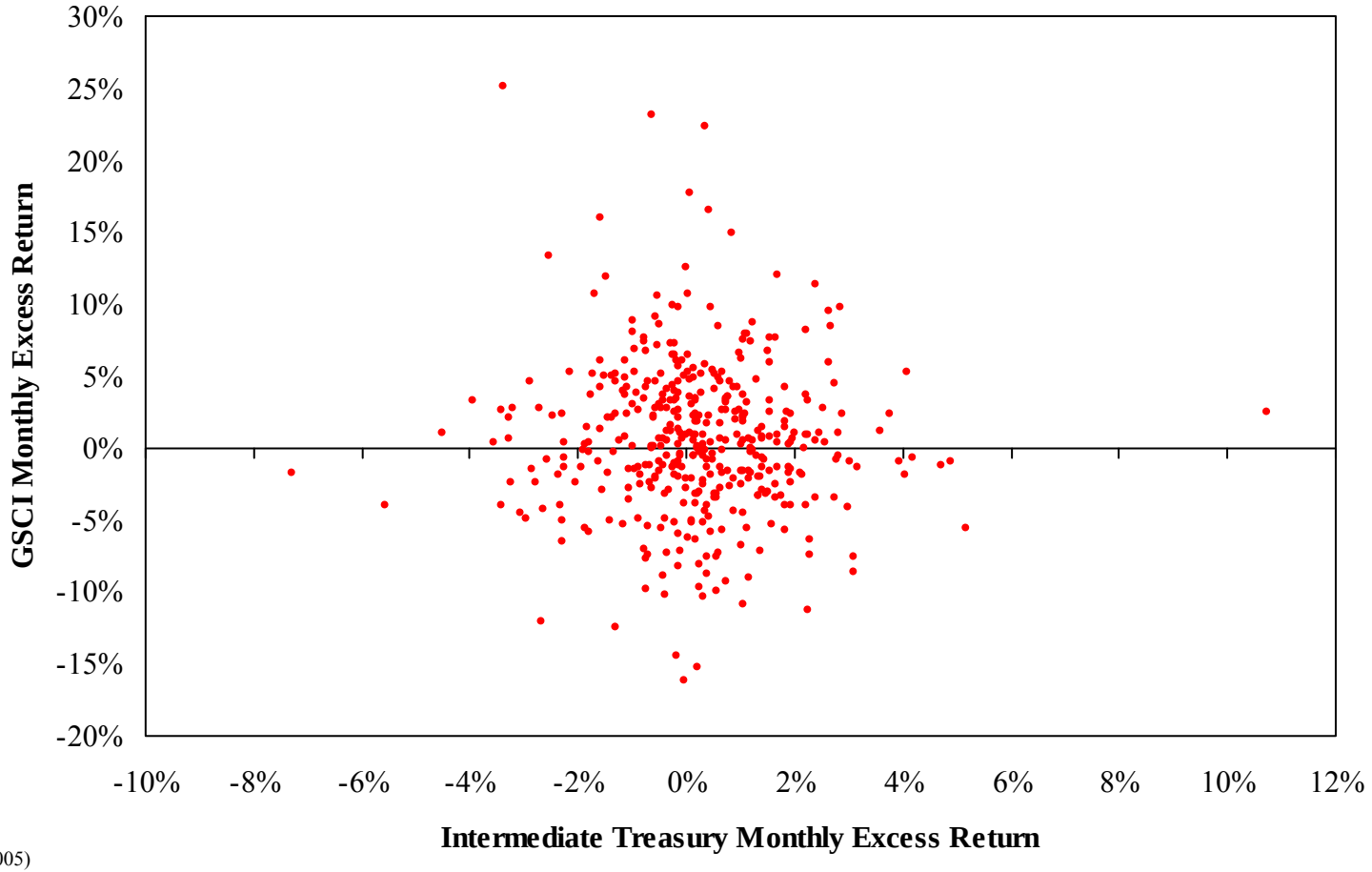
GSCI As A Fixed Income Hedge?

December 1969 to May 2004

- No evidence that commodity futures are a fixed income hedge
- Returns largely uncorrelated

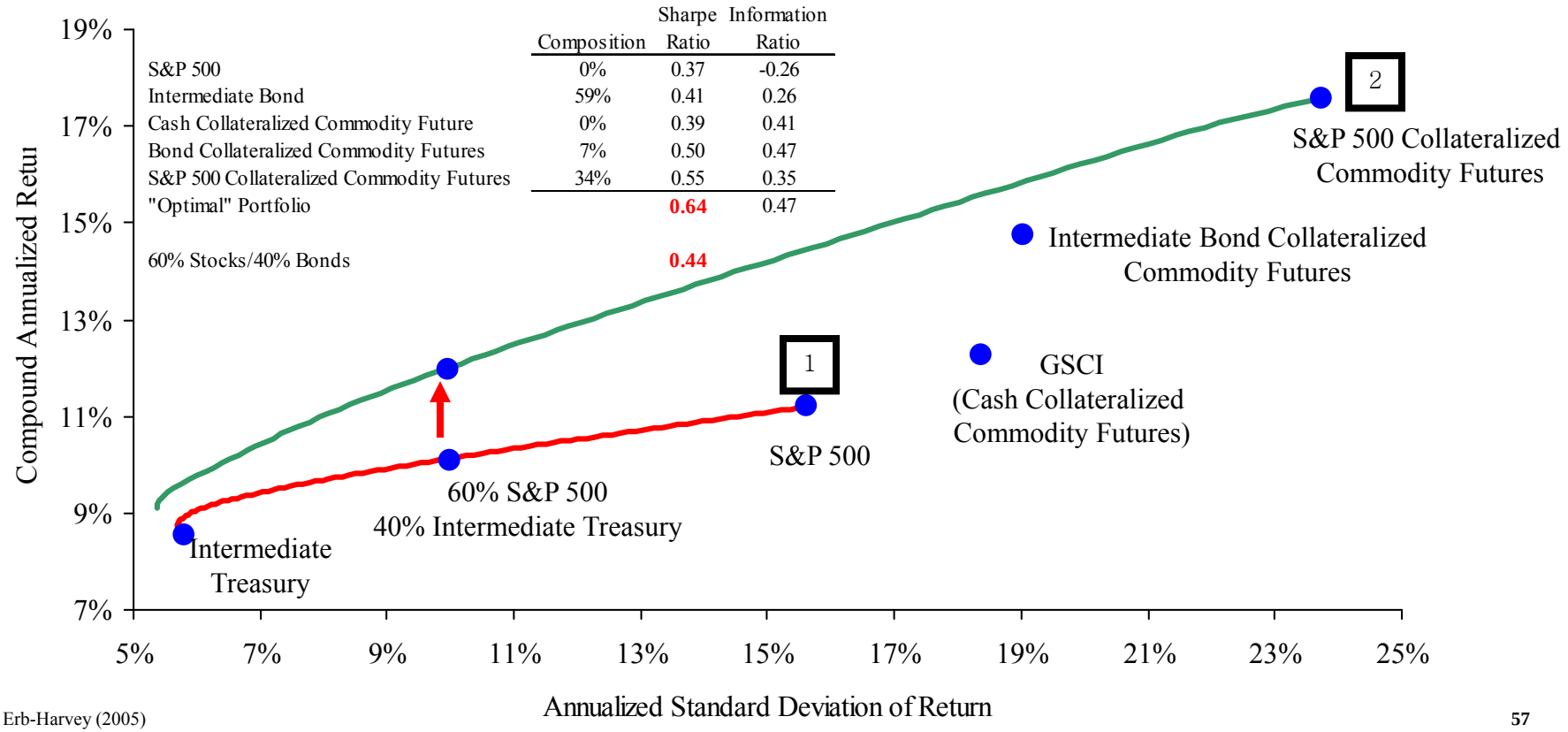
Frequency of Monthly Excess Return Observations

	Bond Excess Return>0	Bond Excess Return<0
GSCIExcess Return>0	**28.88%**	25.30%
GSCI Excess Return<0	26.73%	**18.62%**



Commodity Futures Strategic Asset Allocation
December 1969 to May 2004

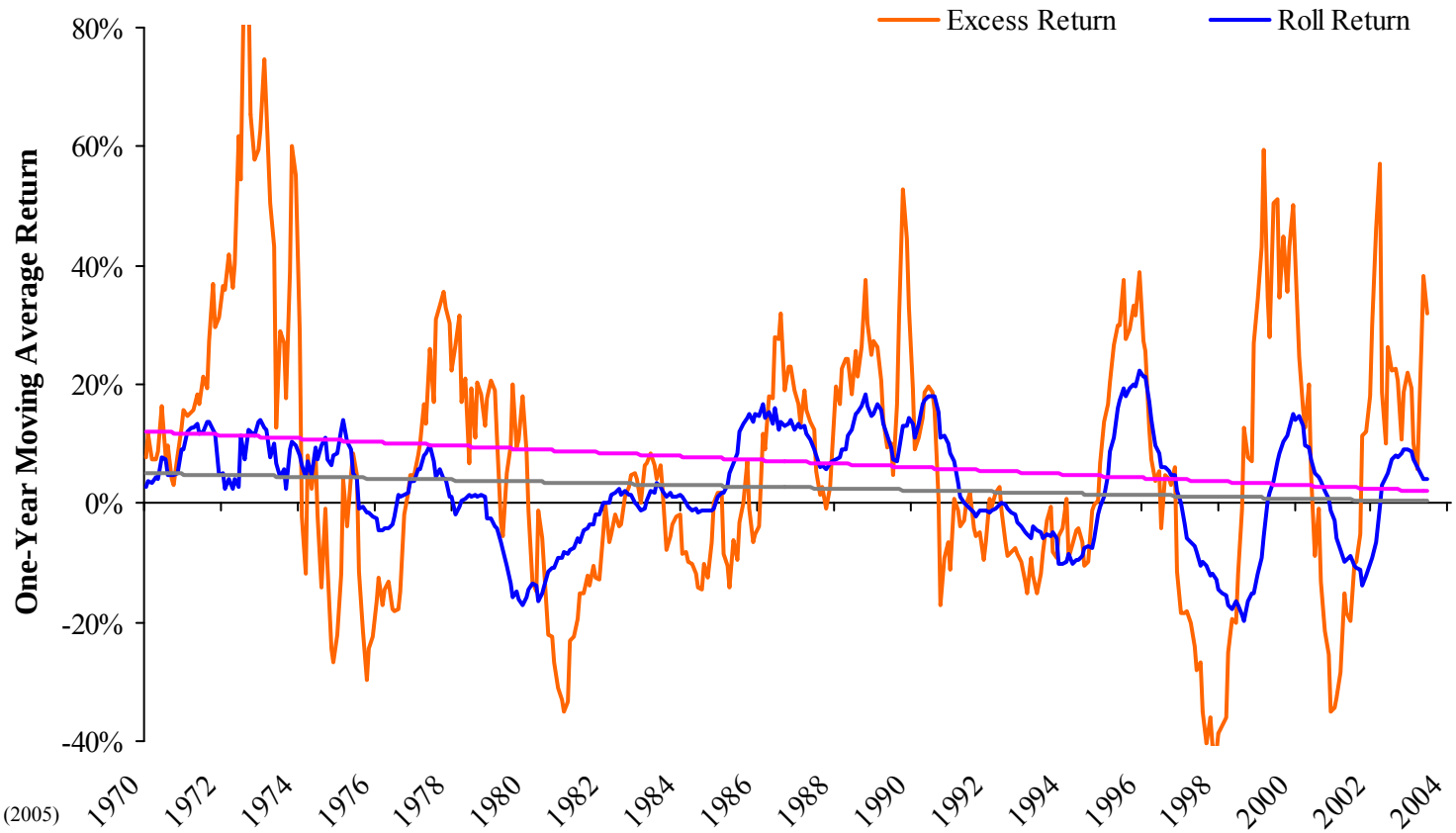
- Historically, cash collateralized commodity futures have been a no-brainer
  - Raised the Sharpe ratio of a 60/40 portfolio
- What about the future?
- How stable has the GSCI excess return been over time?



Rolling One-Year GSCI Excess and Roll Returns

December 1969 to May 2004

- However, the excess return "trend" seems to be going to wrong direction
  - Excess and roll returns have been trending down
- Is too much capital already chasing too few long-only "insurance" opportunities?
  - No use providing more "risk transfer" than the market needs



So Now What?

- Let's look at four tactical approaches
- Basically this says go long or short commodity futures based on a signal
- Since the term structure seems to drive long-term returns,
  - Use the term structure as a signal
- Since the term structure is correlated with returns,
  - Use momentum as a term structure proxy

1. Using the Information in the Overall GSCI Term Structure for a Tactical Strategy

July 1992 to May 2004

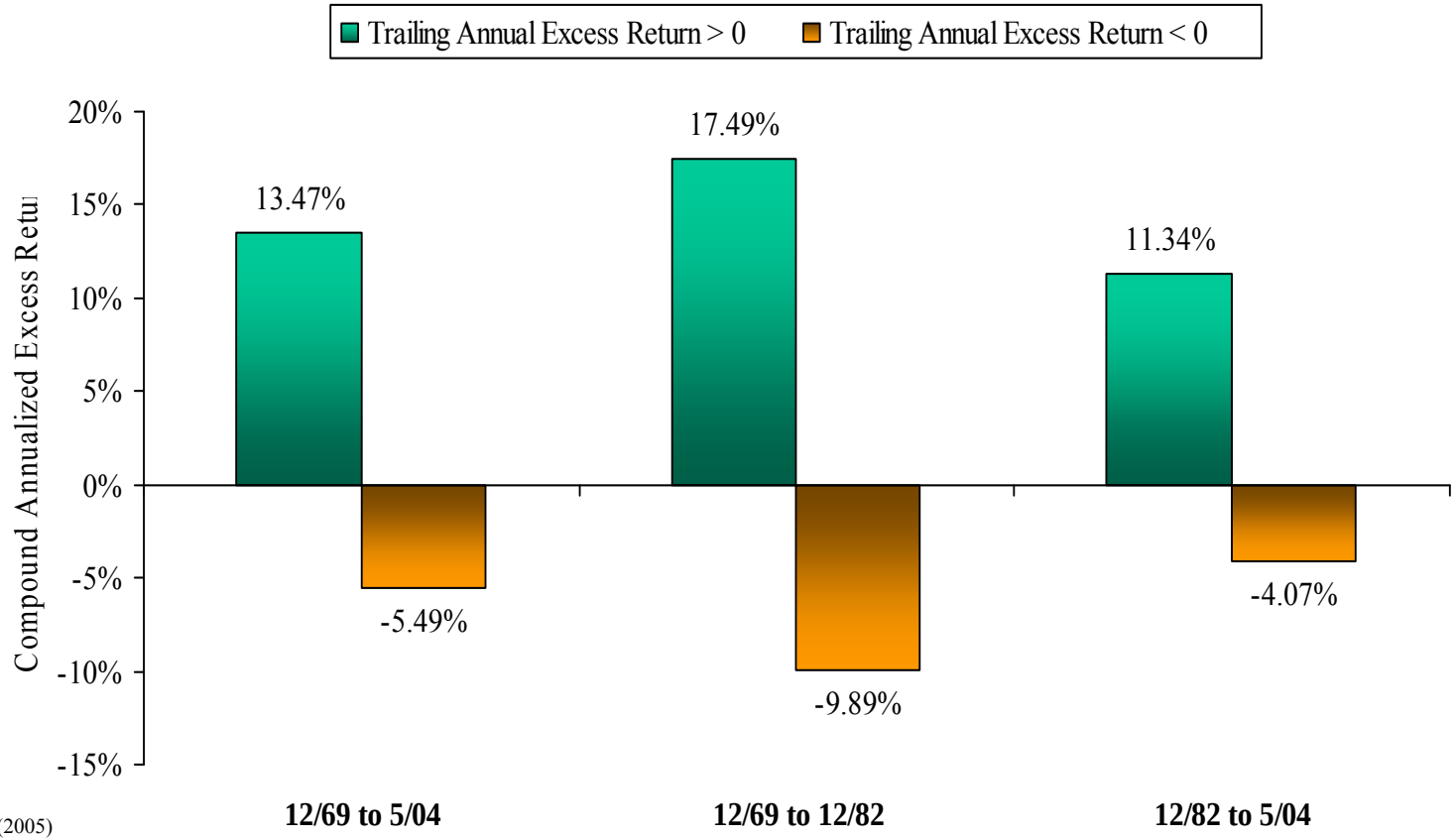
- When the price of the nearby GSCI futures contract is greater than the price of the next nearby futures contract (when the GSCI is backwardated), we expect that the long-only excess return should, on average, be positive.

	Compound Annualized Excess Return	Annualized Standard Deviation	Sharpe Ratio
GSCI Backwardated	11.25%	18.71%	0.60
GSCI Contangoed	-5.01%	17.57%	-0.29
Long if Backwardated, Short if Contangoed	**8.18%**	**18.12%**	**0.45**
Cash Collateralized GSCI	2.68%	18.23%	0.15

2. Overall GSCI Momentum Returns

December 1982 to May 2004

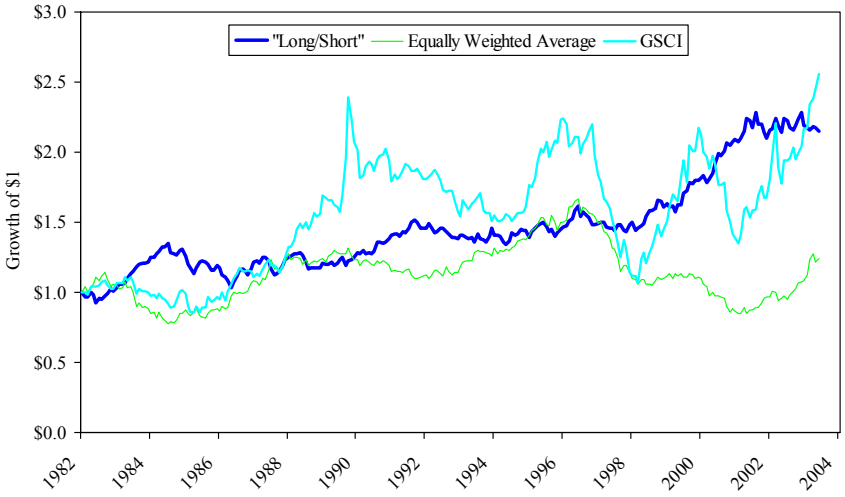
- Go long the GSCI for one month if the previous one year excess return has been positive or go short the GSCI if the previous one year excess return has been negative.
- Momentum can then been seen as a "term structure proxy"



3. Individual Commodity Term Structure Portfolio

December 1982 to May 2004

- Go long the six most backwardated constituents and go short the six least backwardated constituents.



	Compound Annualized Excess Return	Annualized Standard Deviation	Sharpe Ratio
Long/Short	**3.65%**	**7.79%**	**0.47**
EW Portfolio	1.01%	10.05%	0.10
GSCI	4.49%	16.97%	0.26

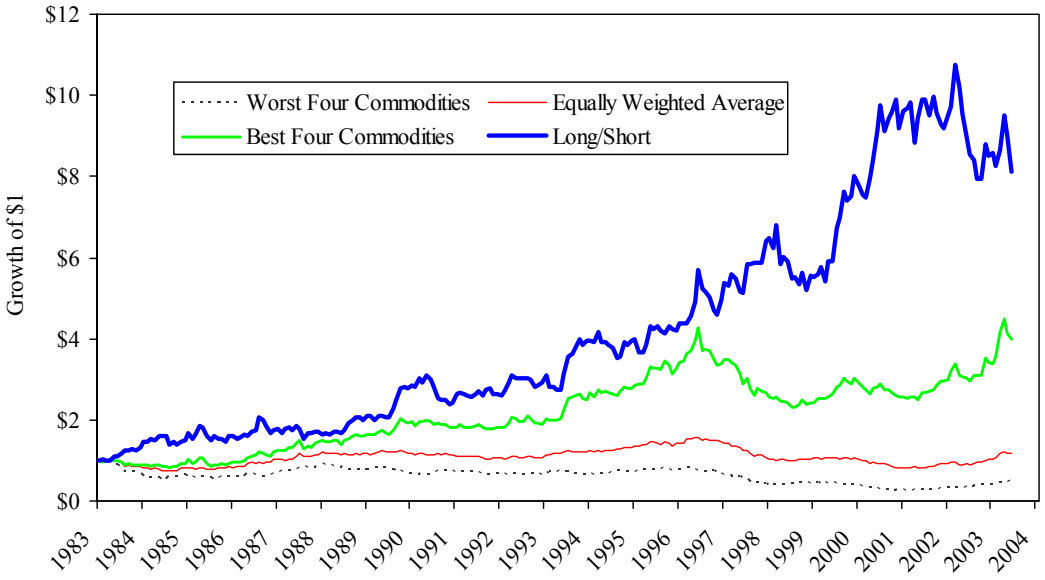
Trading strategy is an equally weighted portfolio of twelve components of the GSCI. The portfolio is rebalanced monthly. The 'Long/Short' portfolio goes long those six components that each month have the highest ratio of nearby future price to next nearby futures price, and the short portfolio goes short those six components that each month have the lowest ratio of nearby futures price to next nearby futures price.

Erb-Harvey (2005)

4a. Individual Commodity Momentum Portfolios

December 1982 to May 2004

- Invest in an equally-weighted portfolio of the four commodity futures with the highest prior twelve-month returns, a portfolio of the worst performing commodity futures, and a long/short portfolio.



	Compound Annualized Excess Return	Annualized Standard Deviation	Sharpe Ratio
Worst Four	-3.42%	16.00%	-0.21
EW Average	0.80%	9.97%	0.08
Best Four	7.02%	15.77%	0.45
Long/Short	**10.81%**	**19.63%**	**0.55**
GSCI	4.39%	17.27%	0.25

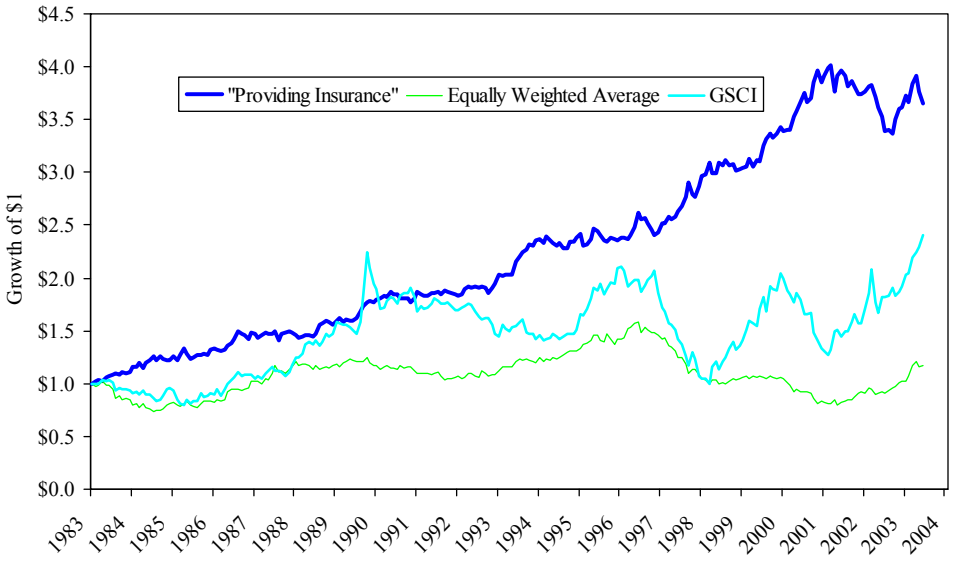
Erb-Harvey (2005)

Trading strategy sorts each month the 12 categories of GSCI based on previous 12-month return. We then track the four GSCI components with the highest ('best four') and lowest ('worst four') previous returns. The portfolios are rebalanced monthly.

4b. Individual Commodity Momentum Portfolio Based on the Sign of the Previous Return

December 1982 to May 2004

- Buy commodities that have had a positive return and sell those that have had a negative return over the past 12 months.
- It is possible that in a particular month that all past returns are positive or negative.
- Call this the "providing insurance" portfolio.



	Compound Annualized Excess Return	Annualized Standard Deviation	Sharpe Ratio
Providing Insurance	**6.54%**	**7.65%**	**0.85**
EW Portfolio	0.80%	9.97%	0.08
GSCI	4.39%	17.27%	0.25

Trading strategy is an equally weighted portfolio of twelve components of the GSCI. The portfolio is rebalanced monthly. The 'Providing Insurance' portfolio goes long those components that have had positive returns over the previous 12 months and short those components that had negative returns over the previous period.

Conclusions

- The expected future excess return is mainly the expected future roll return
- Sometimes the diversification return is confused with the average excess return
- Standard commodity futures 'faith-based' argument is flawed
  - That is, normal backwardation is rejected in the data
- Alternatively, invest in what you actually know
  - The term structure
- Long-only investment only makes sense if all commodities are backwardated
- If the term structure drives returns, long-short seems like the best strategy