



The Fundamentals of Commodity Futures Returns

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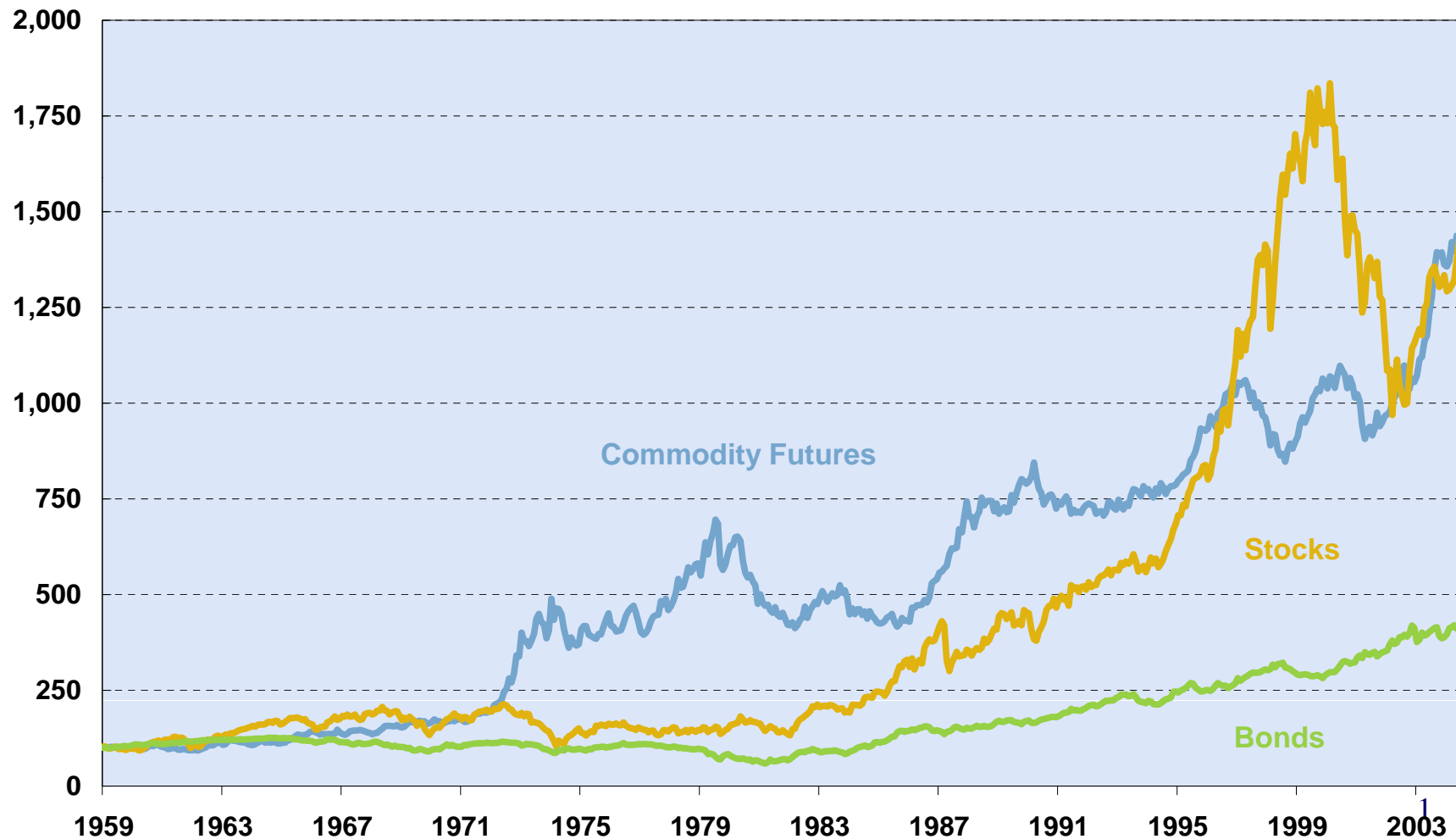
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Commodity Futures, Stocks and Bonds

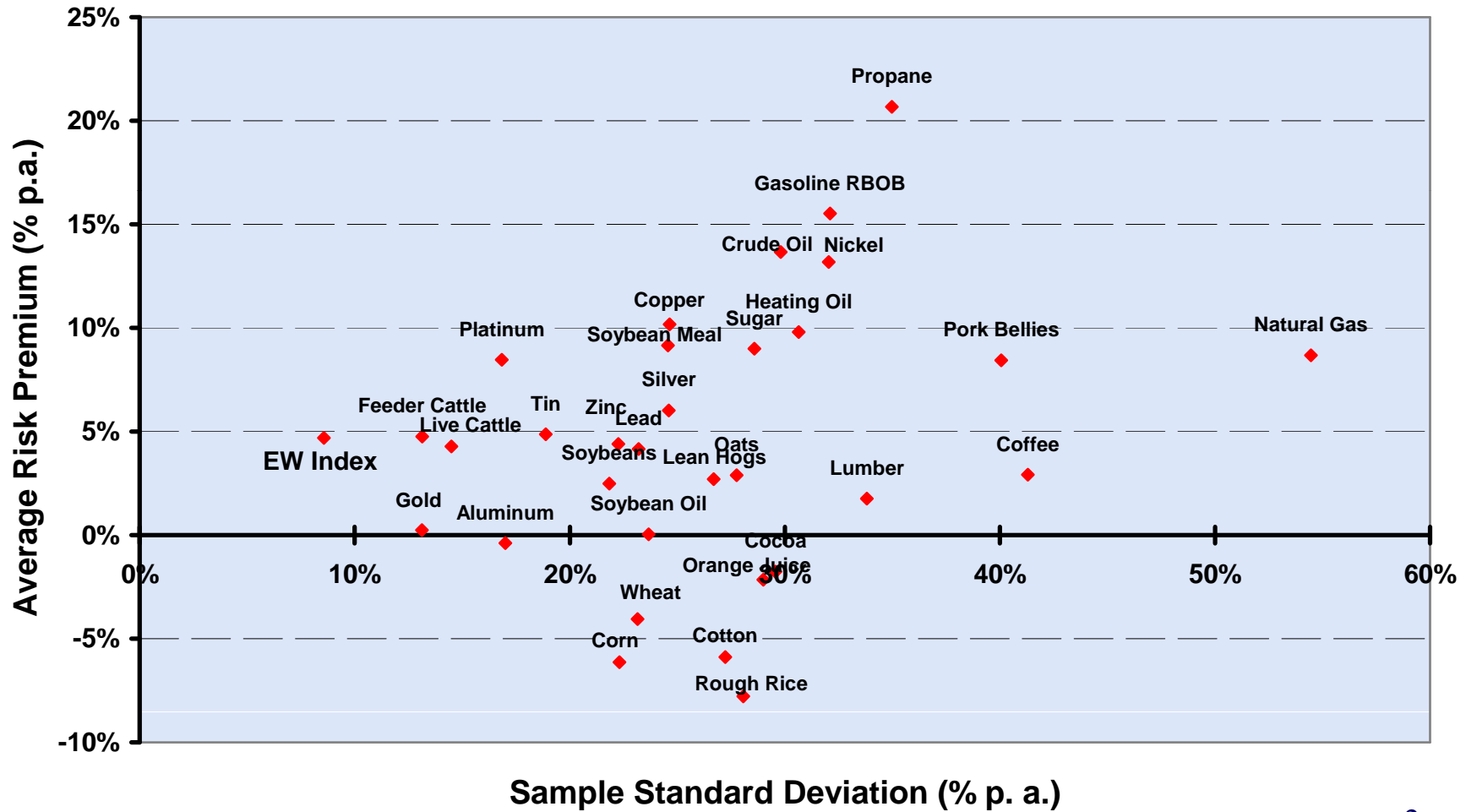
Inflation Adjusted Performance From 1959 to 2004





Risk and Return of Commodity Futures

Annualized Futures Risk Premiums and Stdev by Commodity 1990/12- 2006/12





Explaining the Cross-section of Commodity Futures Risk Premiums

- Commodity futures are “insurance contracts” to transfer commodity price risk
- Insurance premiums are expected to be high when the amount of risk to be insured is high
- Modern Theory of Storage by DL (1992) predicts that expected spot price volatility is decreasing in inventories
- Risk premium of commodity futures should be a negative function of inventories



Data

- Futures Prices:
 - Commodity Research Bureau (CRB)
 - London Metals Exchange (LME)
- Inventory Data:
 - US Department of Energy
 - US Department of Agriculture
 - NYBOT, LME warehouse stocks
 - American Forest & Paper Association
 - USDA Livestock and Seed Division



Issues with Inventory Data

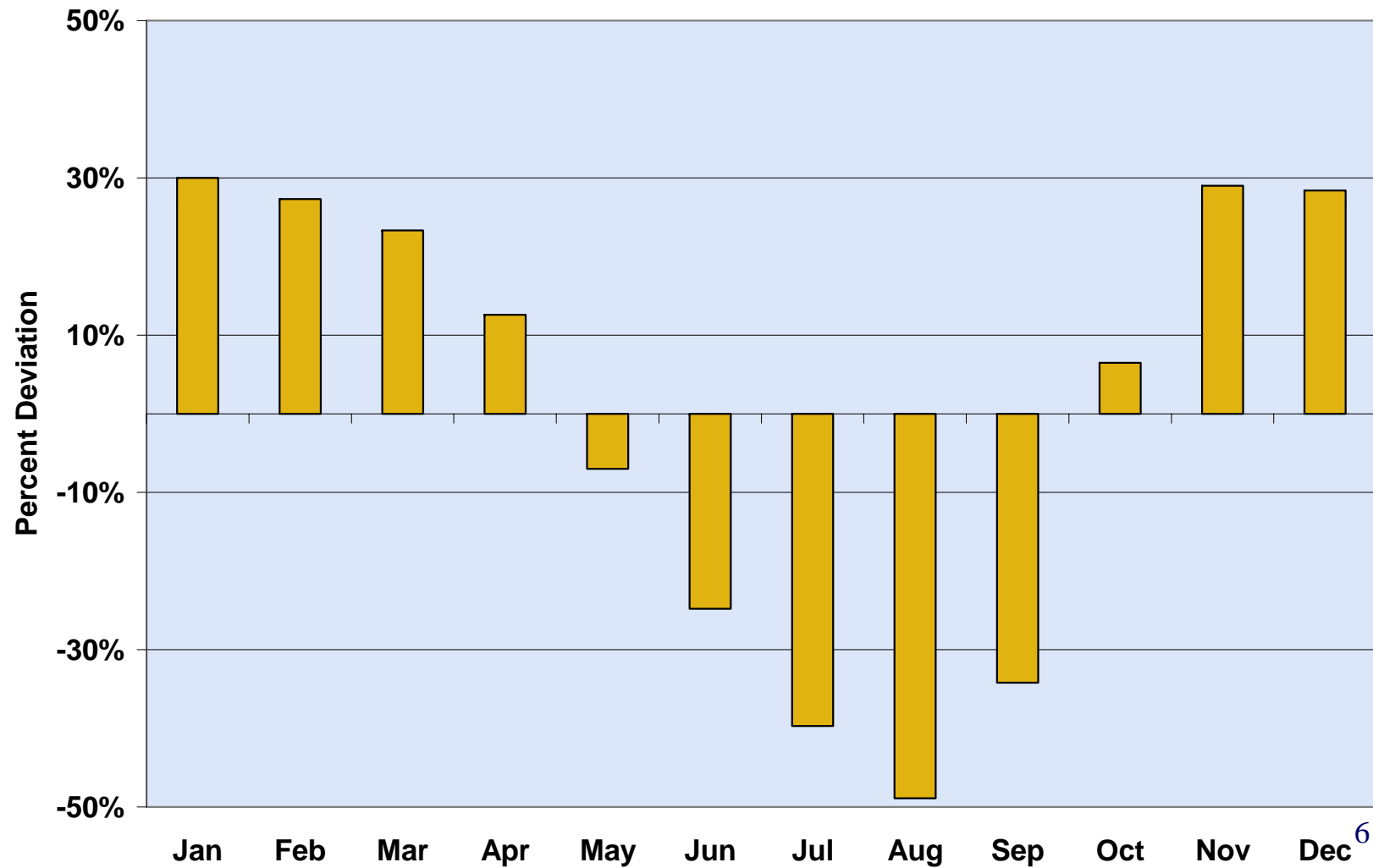
- Measurement
 - Which inventories are relevant?
 - Data revisions
 - Publication lags

- Statistical Issues
 - Trends: we applied a HP filter to the data
 - Seasonality of inventories



Seasonality of Inventories: Corn (Table 2)

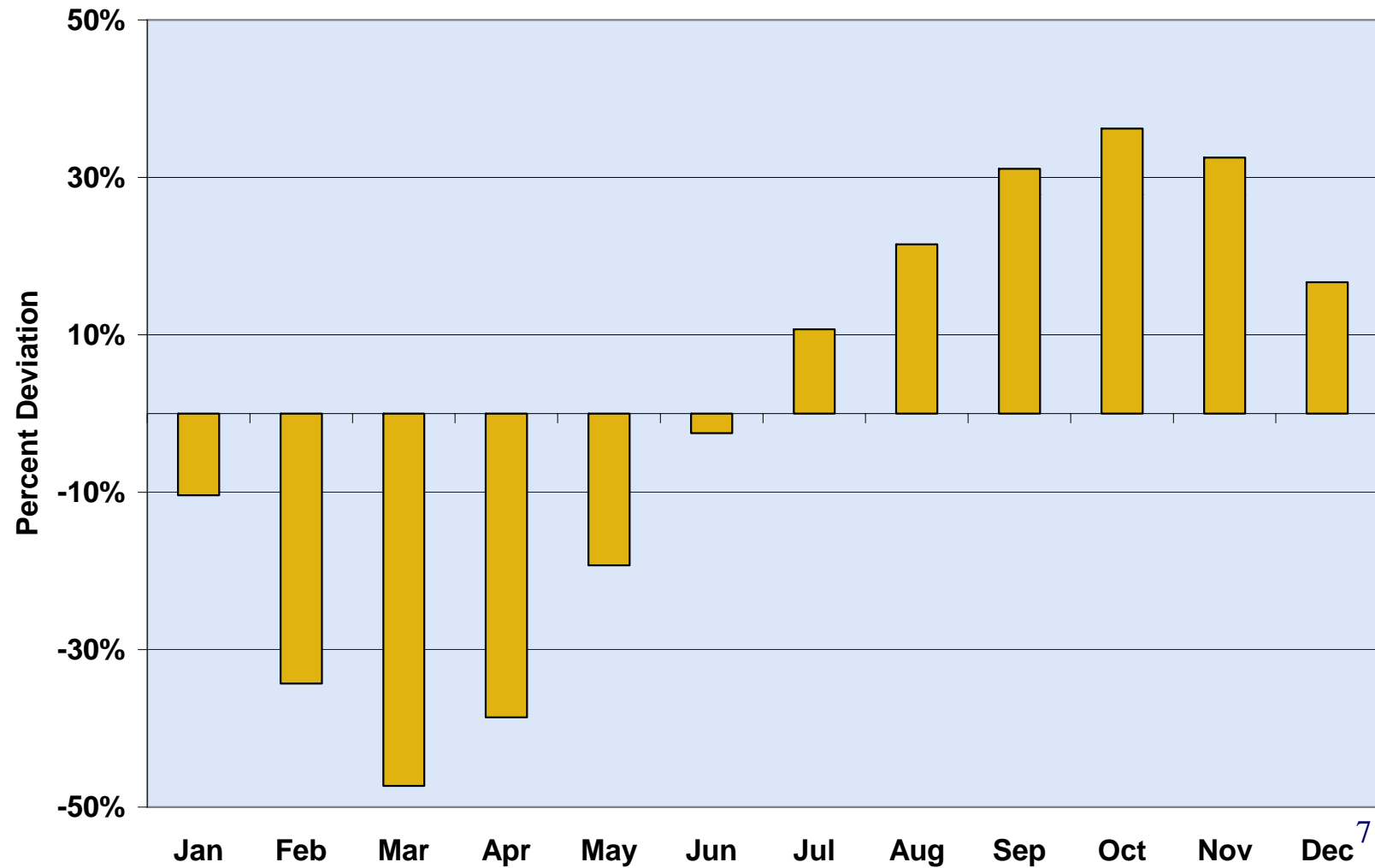
Seasonal Variation of Corn Inventories
Deviation of Inventories from Trend 1974/6-2006/12





Seasonality of Inventories: Natural Gas

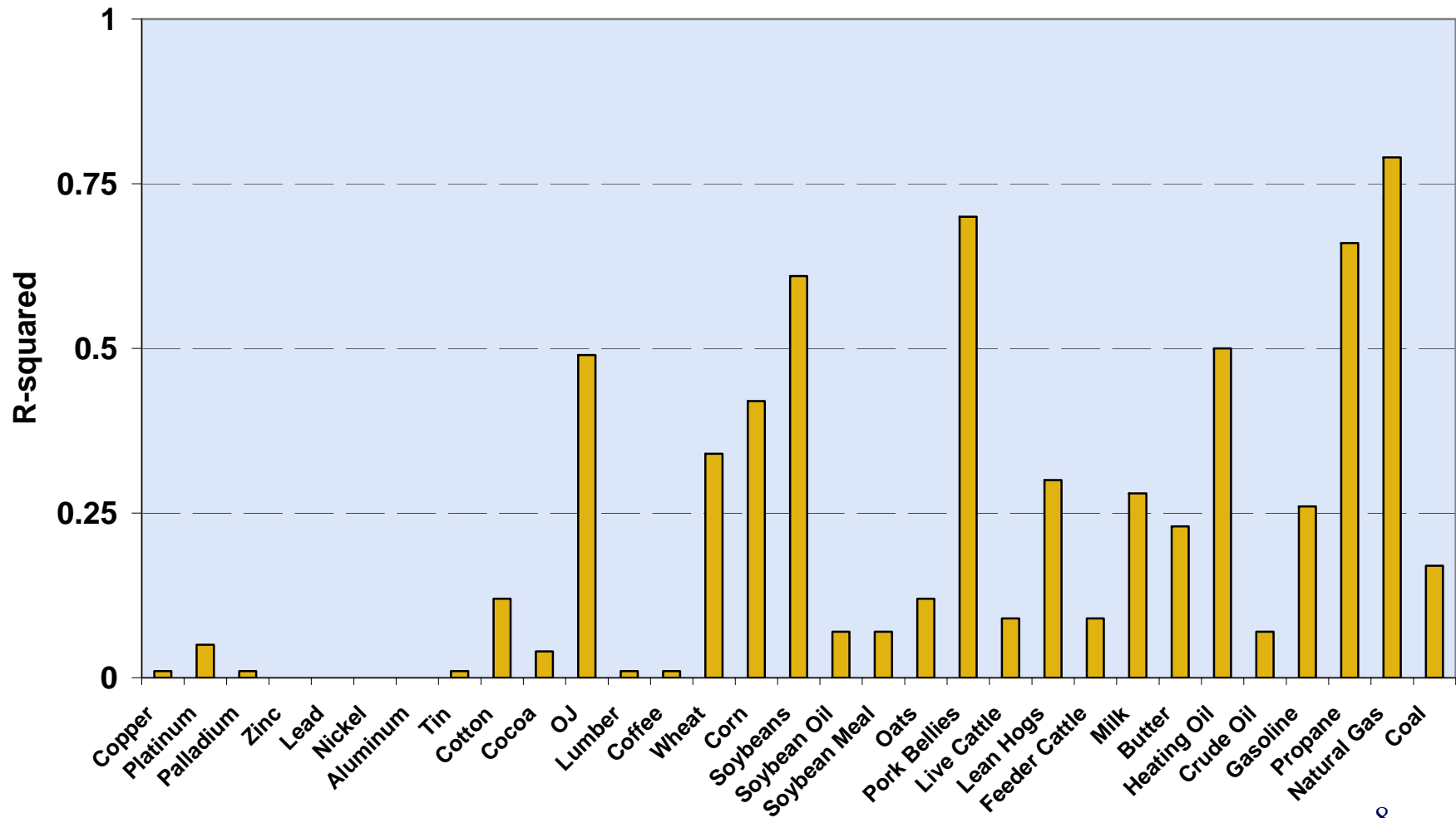
Seasonal Variation of Natural Gas Inventories
Deviation of Inventories from Trend 1975/9-2006/12





Seasonality (Table 2)

Seasonality of Physical Inventories
 R-squared of Regressing Detrended Inventories on Monthly Dummies

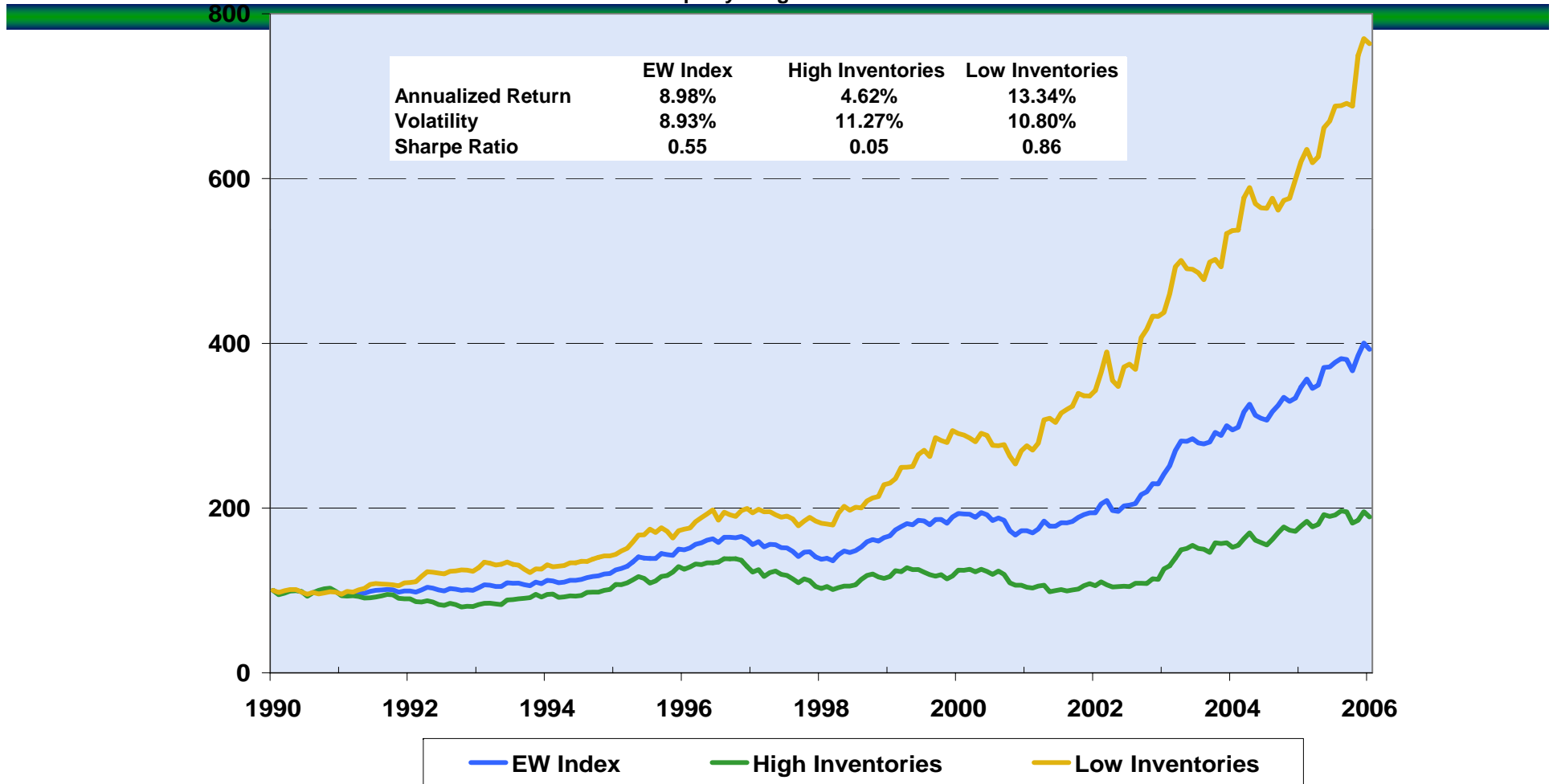




Risk Premiums and Inventory-Sorted Portfolios

Cumulative Returns Inventory Sorted Portfolios

Performance of Equally-weighted Portfolios 12/1990-12/2006





Returns and Characteristics of Portfolios Sorted on Relative Inventories (Table 5)

1969/12-2006/12

1986/1-2006/12

1990/12-2006/12

Panel A: Returns Relative to EW Index

	High	Low	H-L	High	Low	H-L	High	Low	H-L
Mean	-3.85	4.21	-8.06	-3.64	3.61	-7.25	-4.38	4.37	-8.75
Standard Deviation	7.77	7.80	15.48	7.03	7.04	14.02	6.44	6.47	12.84
<i>t</i> -statistic (mean)	-3.03	3.32	-3.19	-2.34	2.33	-2.34	-2.83	2.80	-2.82
% Excess Return>0	42.57	56.53	43.47	41.04	57.37	42.23	41.67	57.29	43.23

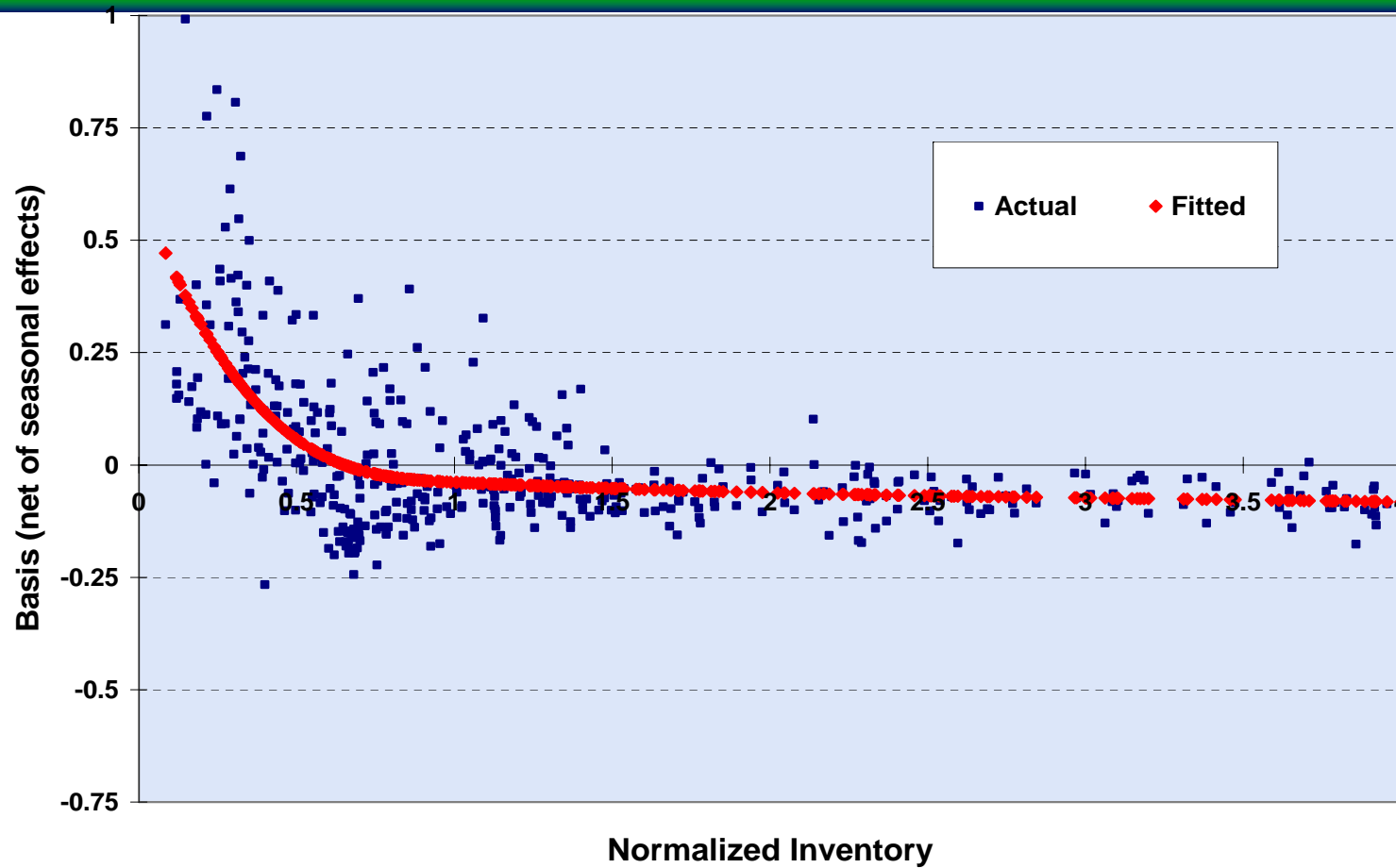
Panel B: Average Portfolio Characteristics

	High	Low	<i>t</i> -stat	High	Low	<i>t</i> -stat	High	Low	<i>t</i> -stat
Prior 12m futures return	0.41	15.31	-6.45	1.24	12.97	-5.54	0.05	11.20	-5.43
Prior 12m spot return	6.00	9.78	-2.58	5.00	8.85	-2.39	5.33	8.59	-1.95
Basis	-7.78	4.61	-14.51	-6.86	4.51	-11.40	-8.81	2.79	-13.14
Inventories	36.37	-36.15		37.20	-35.19		40.80	-31.07	
Volatility (+1)	23.40	23.86	-1.15	23.75	23.90	-0.27	23.84	23.46	0.66
Commercials				-11.71	-7.97	-5.03	-12.33	-8.00	-4.81
Non-Commercials				5.59	5.28	0.58	6.01	5.66	0.53
Non Reportable				6.08	2.75	5.29	6.27	2.41	5.23



Testing the Traditional Theory of Storage

Basis and Normalized Inventories of Copper

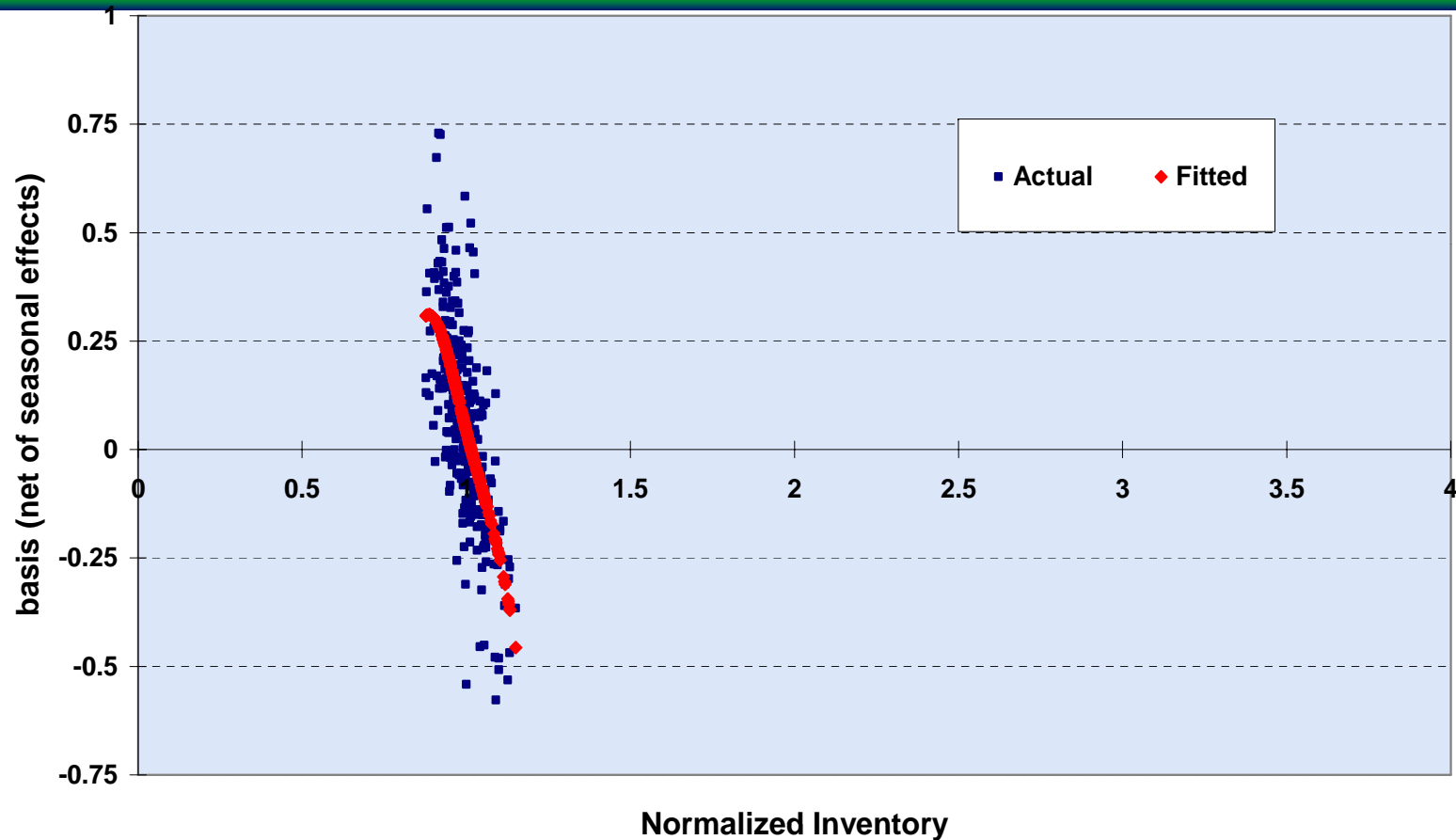


Copper is relatively easy to store...



Testing the Traditional Theory of Storage

Basis and Normalized Inventories for Crude Oil



Crude is relatively expensive to store



Basis and Inventories

Cubic Spline Regression of Basis on Inventories (Table 3)

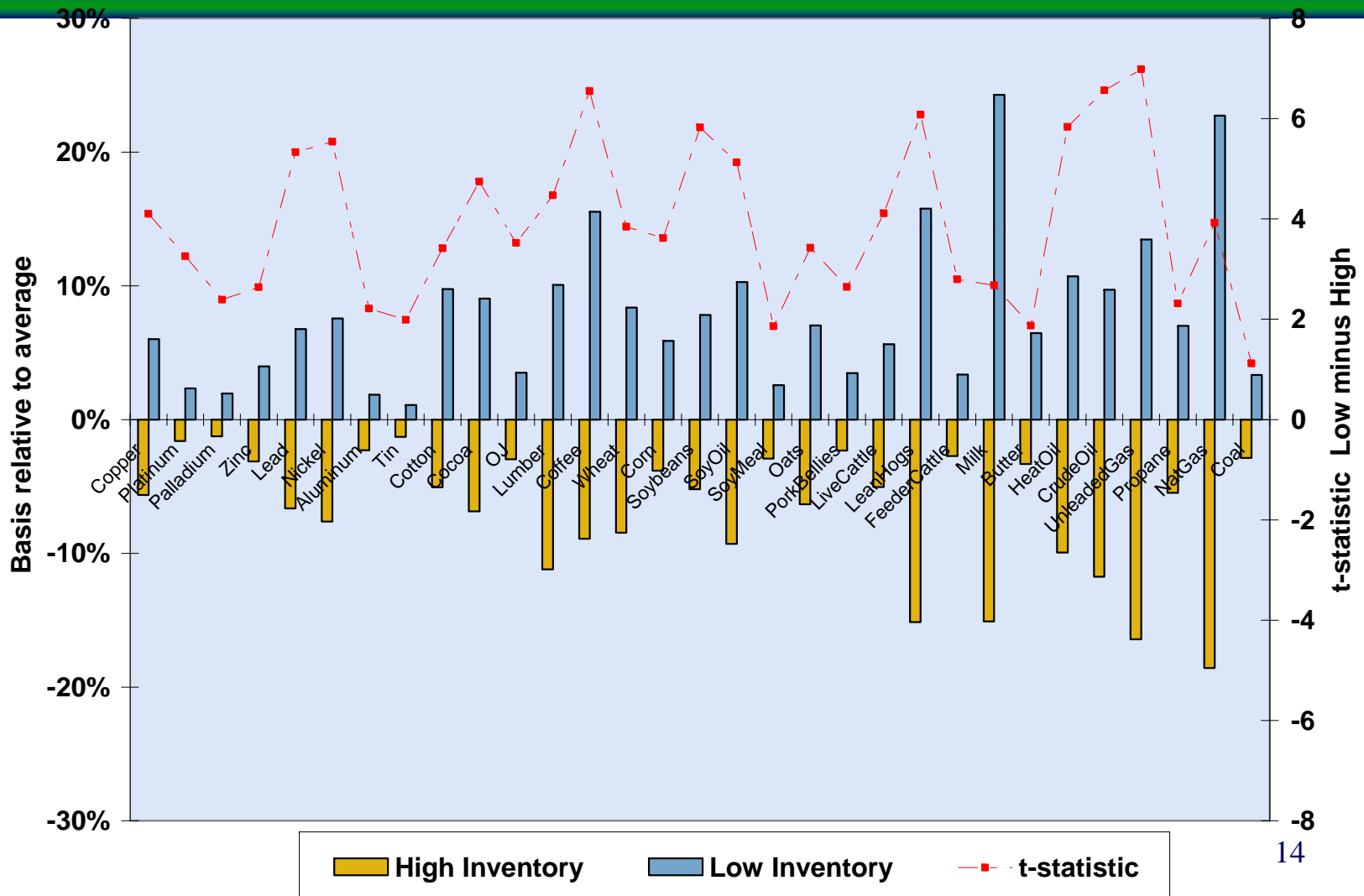
Commodity	slope at 1	t	slope at 0.75	t	difference	t	R-sq
<i>Metals group</i>	-0.051	-2.46	-0.118	-6.01	0.067	4.70	
Copper	-0.032	-0.61	-0.153	-2.76	0.121	5.64	0.41
Platinum	-0.034	-1.10	-0.031	-0.93	-0.003	-0.12	0.41
Palladium	-0.045	-1.46	-0.032	-1.26	-0.013	-1.03	0.19
Zinc	-0.019	-0.39	-0.096	-2.22	0.076	3.32	0.32
Lead	-0.146	-2.83	-0.270	-5.57	0.124	4.34	0.54
Nickel	-0.039	-1.06	-0.136	-4.13	0.096	5.95	0.55
Aluminum	-0.057	-1.64	-0.094	-2.86	0.037	2.16	0.25
Tin	-0.001	-0.02	-0.093	-3.03	0.092	5.06	0.40
<i>Softs group</i>	-0.193	-5.65	-0.257	-8.37	0.064	4.93	
<i>Grains group</i>	-0.214	-5.10	-0.251	-5.02	0.037	1.39	
<i>Meats group</i>	-0.598	-7.03	-0.602	-6.27	0.004	0.12	
<i>Energies group</i>	-1.546	-7.61	-1.496	-4.15	-0.050	-0.16	

Inventory sensitivity varies across commodity groups



State of Inventories and the Basis

Average Basis and Normalized Inventories
Monthly Data 1969/12-2006/12





Returns and Characteristics of Portfolios Sorted on Futures Basis (Table 6)

1969/12-2006/12

1986/1-2006/12

1990/12-2006/12

Panel A: Returns Relative to EW Index

	High	Low	H-L	High	Low	H-L	High	Low	H-L
Mean	5.42	-4.82	10.23	5.04	-4.70	9.74	5.71	-5.86	11.57
Standard Deviation	7.76	7.93	15.58	6.87	7.13	13.93	6.08	6.08	12.10
<i>t</i> -statistic (mean)	3.98	-3.44	3.73	3.55	-3.14	3.36	4.04	-4.10	4.08
% Excess Return>0	58.56	42.79	57.88	61.35	39.04	61.35	63.02	37.50	63.02

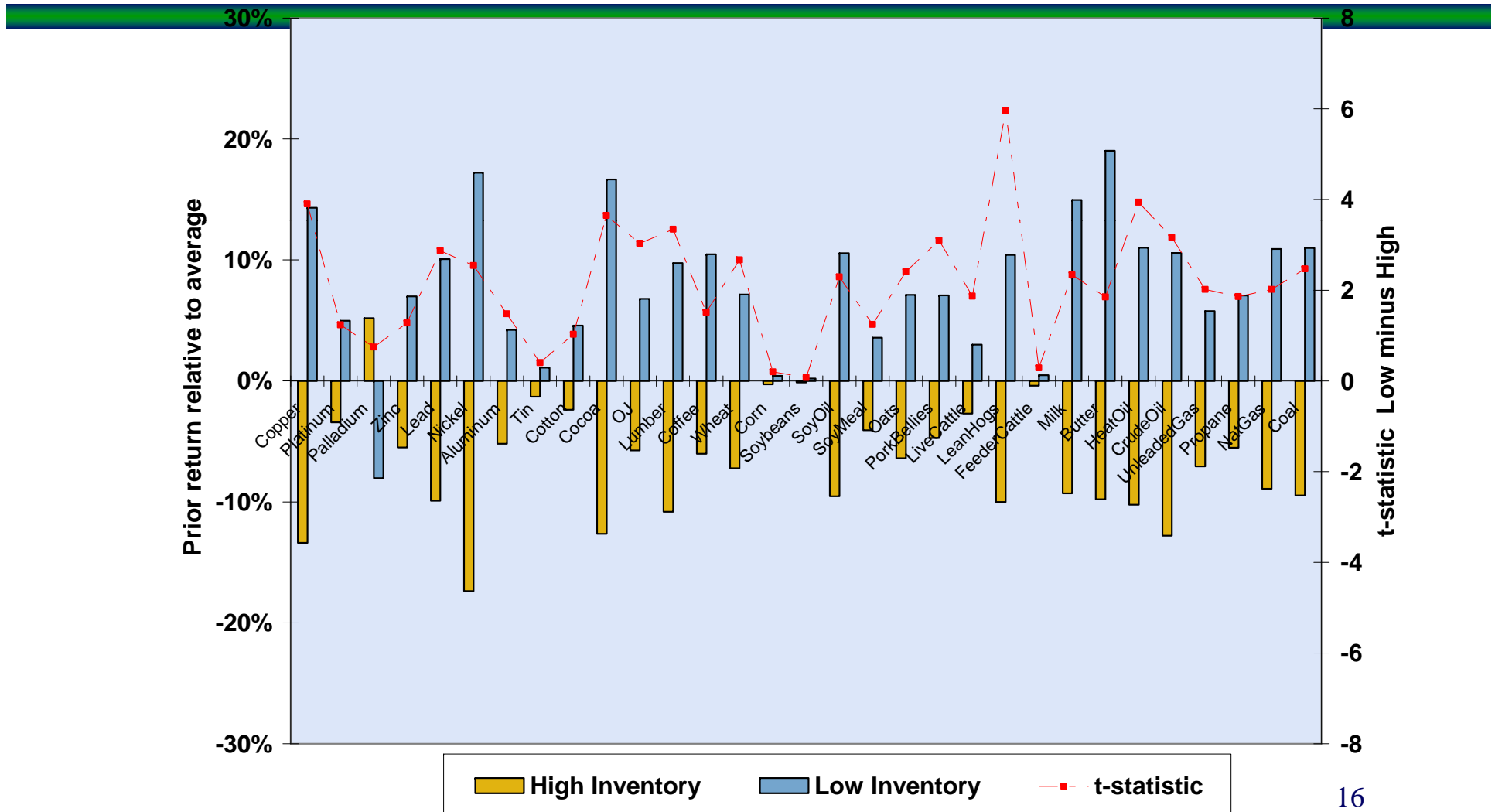
Panel B: Average Portfolio Characteristics

	High	Low	<i>t</i> -stat	High	Low	<i>t</i> -stat	High	Low	<i>t</i> -stat
Prior 12m futures return	21.02	-5.11	12.93	19.68	-5.40	12.99	17.50	-5.93	10.56
Prior 12m spot return	15.61	0.29	10.45	14.39	-0.51	9.51	14.11	0.00	7.16
Basis	15.32	-18.40		15.44	-17.73		13.04	-19.01	
Inventories	-14.87	15.31	-17.08	-13.78	15.95	-13.65	-9.34	19.09	-13.76
Volatility (+1)	24.07	23.23	2.13	24.30	23.31	1.72	23.98	23.30	0.99
Commercials				-8.94	-10.34	1.46	-9.87	-10.01	0.13
Non-Commercials				6.89	3.95	4.24	7.78	3.92	4.81
Non Reportable				2.38	6.12	-7.00	2.52	5.73	-5.99



State of Inventories and Prior Futures Returns

Prior 12-month Return and Normalized Inventories
Monthly Data 1969/12-2006/12





Returns and Characteristics of Portfolios Sorted on Prior 12-month Futures Return (Table 7)

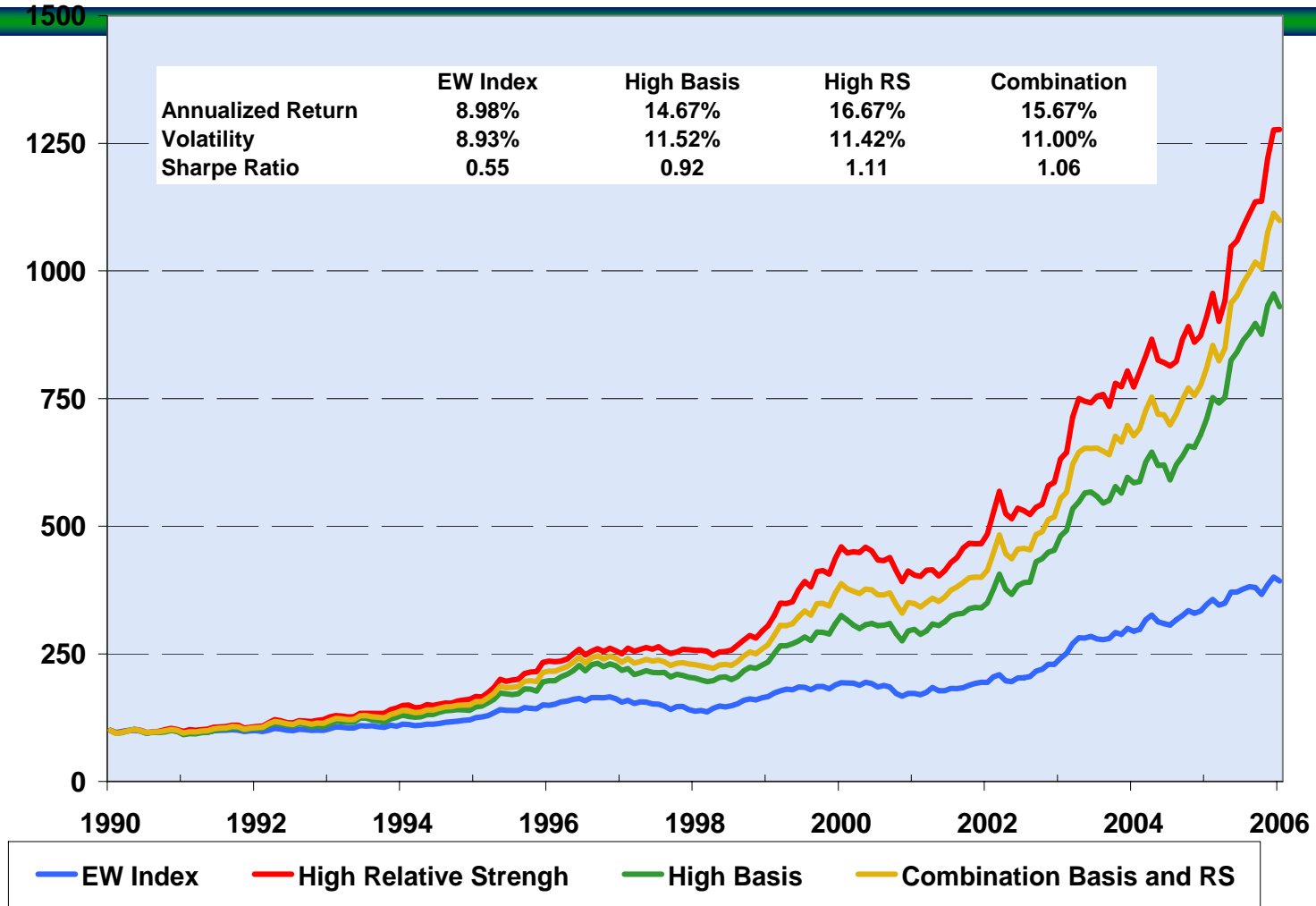
	1969/12-2006/12			1986/1-2006/12			1990/12-2006/12		
Panel A: Returns Relative to EW Index									
	High	Low	H-L	High	Low	H-L	High	Low	H-L
Mean	6.54	-6.82	13.36	6.81	-7.03	13.84	7.69	-7.67	15.36
Standard Deviation	8.52	8.62	16.99	7.80	7.90	15.53	6.84	6.83	13.64
<i>t</i> -statistic (mean)	4.82	-4.95	4.93	4.24	-4.35	4.34	4.56	-4.62	4.60
% Excess Return>0	58.78	42.34	58.11	61.35	39.44	60.96	64.58	35.42	64.58
Panel B: Average Portfolio Characteristics									
	High	Low	<i>t</i> -stat	High	Low	<i>t</i> -stat	High	Low	<i>t</i> -stat
Prior 12m futures return	32.62	-16.65		31.57	-17.14		29.40	-17.79	
Prior 12m spot return	26.22	-10.43	23.52	25.54	-11.70	24.16	25.37	-11.23	20.33
Basis	6.73	-9.96	19.15	6.94	-9.30	17.97	5.03	-11.08	14.73
Inventories	-9.30	9.88	-8.26	-7.29	9.44	-6.07	-3.51	13.29	-5.74
Volatility (+1)	24.10	23.28	1.71	24.43	23.24	1.83	24.37	22.97	1.83
Commercials				-11.57	-8.01	-2.73	-12.53	-7.46	-3.61
Non-Commercials				9.02	1.58	9.81	10.11	1.24	11.72
Non Reportable				2.74	6.18	-4.31	2.67	5.89	-3.67



Trading Strategies of Price-based Measures of Inventories

Cumulative Performance High Basis and Prior Return Portfolios

Performance of Equally-weighted Portfolios 12/1990-12/2006





Returns and Characteristics of Portfolios Sorted on Prior 12-month Spot Return (Table 8)

1969/12-2006/12

1986/1-2006/12

1990/12-2006/12

Panel A: Returns Relative to EW Index

	High	Low	H-L	High	Low	H-L	High	Low	H-L
Mean	6.73	-7.12	13.85	8.55	-8.82	17.37	7.87	-8.16	16.03
Standard Deviation	8.69	8.58	17.19	8.53	8.34	16.83	6.71	6.78	13.44
<i>t</i> -statistic (mean)	4.77	-5.09	4.95	4.79	-5.07	4.94	4.36	-4.55	4.47
% Excess Return>0	56.76	41.67	57.88	59.76	38.25	60.96	61.46	36.98	61.98

Panel B: Average Portfolio Characteristics

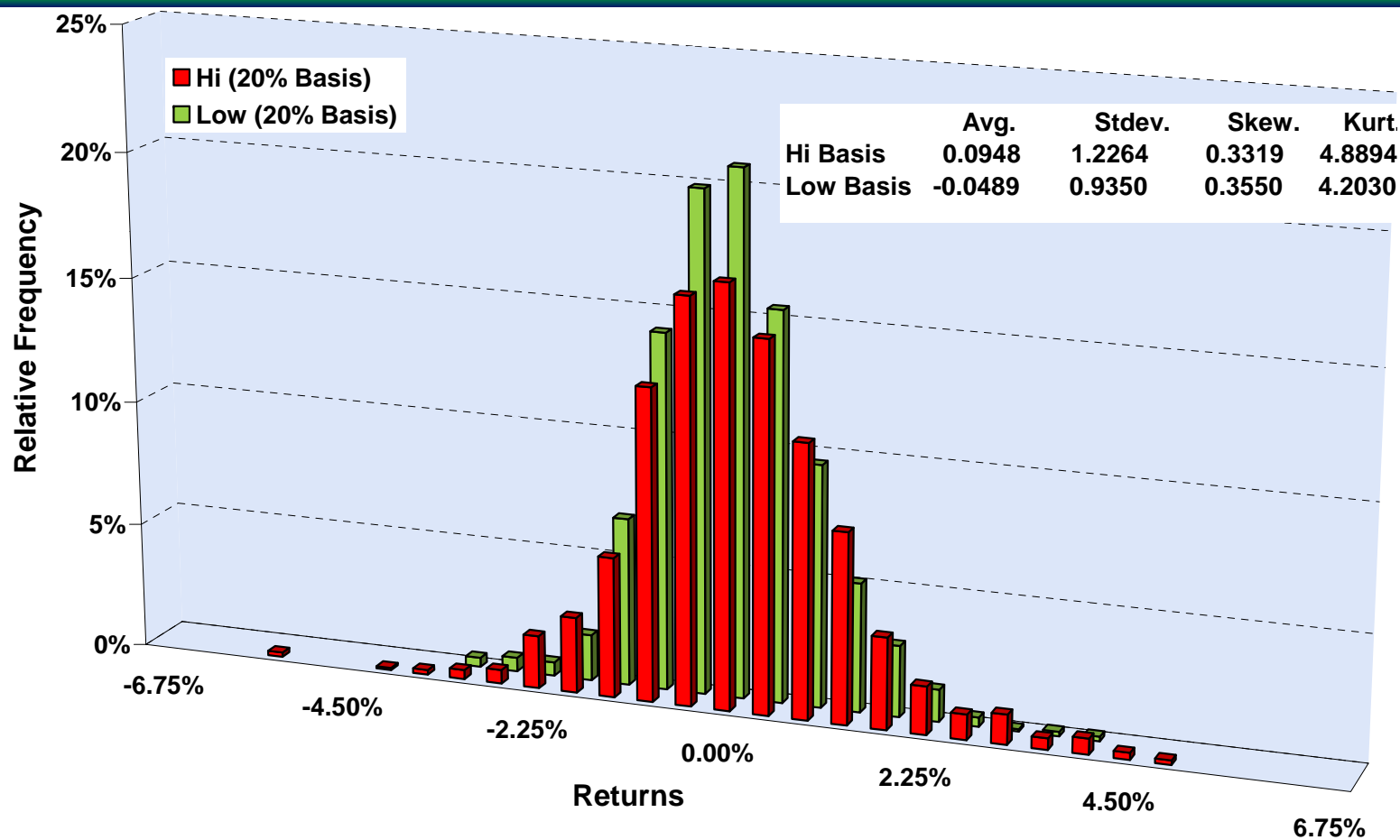
	High	Low	<i>t</i> -stat	High	Low	<i>t</i> -stat	High	Low	<i>t</i> -stat
Prior 12m futures return	28.61	-12.79	18.13	27.98	-13.58	22.84	25.99	-14.41	20.56
Prior 12m spot return	29.78	-13.87		28.60	-14.67		28.15	-14.01	
Basis	3.94	-7.08	11.57	4.71	-7.05	12.40	3.00	-9.00	10.22
Inventories	-3.00	3.27	-2.77	-2.25	4.09	-2.51	1.56	8.17	-2.57
Volatility (+1)	24.18	23.25	1.82	24.35	23.33	1.40	24.43	22.90	1.91
Commercials				-13.02	-6.45	-6.29	-14.03	-5.83	-7.80
Non-Commercials				9.60	1.14	13.68	10.59	0.95	16.12
Non Reportable				3.68	5.04	-1.87	3.78	4.53	-0.93



Conditional Volatility and the Futures Basis

Conditional Distributions of Commodity Futures Returns

Normalized Monthly Basis-sorted Returns (1990/12 - 2006/12)





Volatility of Characteristics Sorted Portfolios

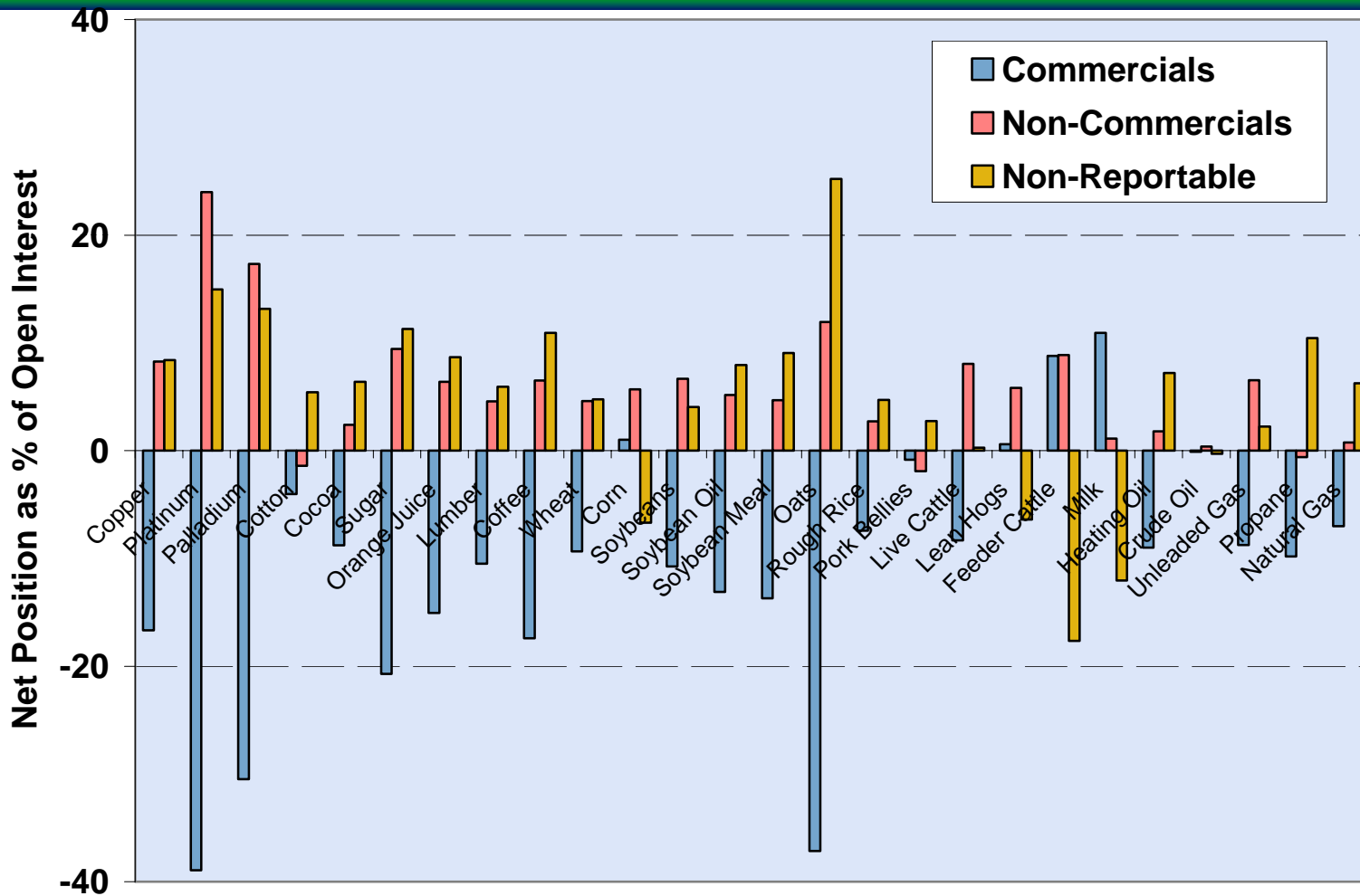
t-test for Equality of Average Futures Return Volatility
of Commodities in High versus Low Portfolios

Characteristic	1969/12-2006/12	1986/1-2006/12	1990/12-2006/12
Panel A: De-meaned data			
Inventories	-1.75	-1.59	-0.78
Basis	3.33	5.61	4.68
Prior 12-month futures return	2.77	3.42	3.49
Prior 12-month spot return	2.82	2.75	3.07
Panel B: Raw data			
Inventories	-1.15	-0.27	0.66
Basis	2.13	1.72	0.99
Prior 12-month futures return	1.71	1.83	1.83
Prior 12-month spot return	1.82	1.40	1.91



Alternative Hypothesis: Hedging Pressure (Table 11)

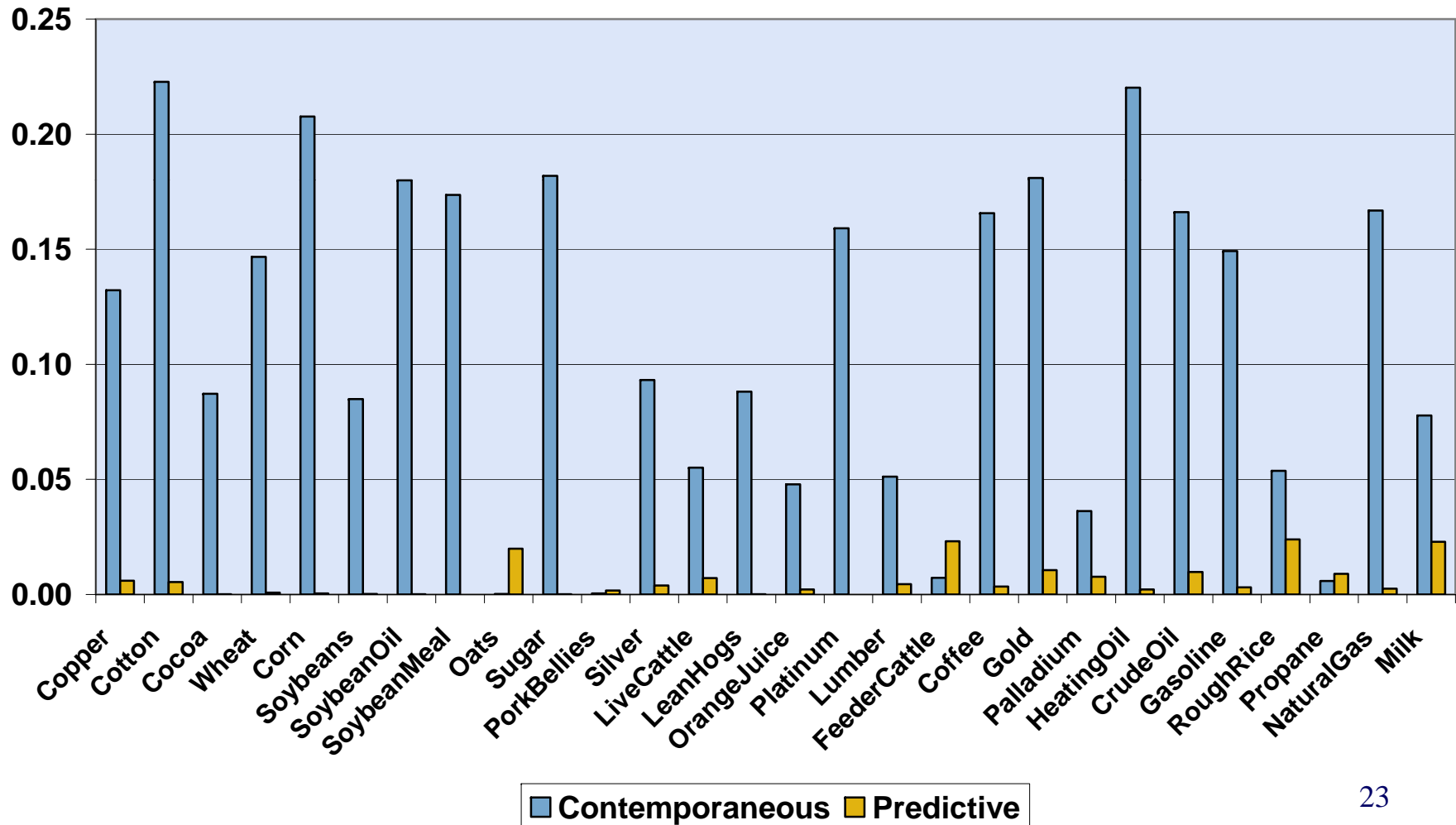
Average Positions of Traders as % of Open Interest
CFTC Classifications 1986 - 2006





Hedging Pressure and Risk Premiums (Table 12)

R-squared of Futures Returns on Commercial Positions
CFTC data 1986/12 - 2006/12





Summary and Conclusions

- We test several predictions of the Theory of Storage for a large cross-section of commodity futures using inventory data. We find that:
 - Basis is negatively related to inventories
 - Relationship is non-linear for many commodities
 - Basis and prior returns are indicators for the state of inventories
 - Inventories, the basis, and prior returns are correlated with expected price volatility and predict future risk premiums
 - We reject Hedging Pressure as an alternative explanation for commodity futures risk premiums
- Future research:
 - Reconcile the empirical evidence with Modern Asset Pricing Theory