The Systematic Risk of Futures Contracts

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INTRODUCTION

This article seeks to shed new light on the old problem of systematic risk and return in futures markets. Most previous studies have been limited to a relatively short span of time, relatively few observations, or relatively few commodities. Other studies have often pooled data from different contract maturities to increase their sample size or have created artificial data to facilitate their statistical analyses.

This study builds on these previous efforts and attempts to answer the following questions. First, do commodity futures positions embody systematic risk as measured within the context of the Capital Asset Pricing Model (CAPM)? Second, are returns on commodity futures positions significantly different from zero? Third, are the returns on commodity futures positions commensurate with the systematic risk of those positions? Since these are essentially empirical questions, more reliable answers can be obtained by considering more data for more commodities gathered over an extended period. This study employs data on 4735 futures contracts drawn from 45 commodities with almost 600,000 daily observations. This extensive data set facilitates a more comprehensive analysis than has been possible previously.

The remainder of this article is organized as follows. The second section describes the previous work in this area and elaborates the theoretical underpinnings of the concern with systematic risk and return in futures markets. The third section describes the data and methodology employed in this study, while the fourth presents and discusses the em-

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pirical results. The last section summarizes the key conclusions of the article.

SYSTEMATIC RISK AND RETURN IN FUTURES MARKETS

In her now classic article, Katherine Dusak (1973) initiated the inquiry into the relationship between systematic risk and return in futures markets within the context of the CAPM. Dusak studied wheat, corn, and soybean futures during the period, 1952 to 1967, and found that these commodity futures generally exhibited returns that were near zero. Betas estimated for these commodities were typically about 0.05, with standard errors in the same range. Dusak concluded that these futures contracts had zero returns and near zero systematic risk. Given that a position in a futures contract requires no investment, Dusak found that these results were consistent with the CAPM.

Bodie and Rosansky (1980) studied the returns of 23 commodity futures from 1950 to 1976 and found positive mean returns for 22 of 23 commodities in their sample, with three of these commodities having returns significantly above zero.[1] Computed betas for these commodities were generally negative, although only sugar had a beta significantly different from zero. Bodie and Rosansky also regressed the returns on futures against the estimated betas and found a negative relationship between beta and return, leading them to conclude that their results were inconsistent with the CAPM.[2]

Whereas both Dusak and Bodie and Rosansky use the S&P 500 as the market index for estimating betas, several subsequent studies explored the systematic risk of futures contracts against alternative market proxies. Carter, Rausser, and Schmitz (1983) used a market index composed of equal weights given to the S&P 500 and the Dow–Jones commodity futures index. Relative to this market proxy, Carter, Rausser, and Schmitz found that approximately half of the commodities they examined had positive betas. Baxter, Conine, and Tamarkin (1985) adopted an approach similar to that of Carter, Rausser, and Schmitz, but gave a weight of 93.7% to the S&P 500 and a weight of 6.3% to the Dow–Jones commodity index.

[1]Bodie and Rosansky considered virtually all of the agricultural commodities available in 1976. Of these 23 commodities, only eggs had a negative mean return. The computed mean return presented in their Table VIII was larger than twice the standard error for soybeans, soybean oil, and copper.

[2]One limitation of the Bodie and Rosansky study is the small number of observations. Because they measure returns as the percentage change in the futures price over a three-month holding period, their maximum number of observations is 27 and for some commodities fewer than 10 observations were available.

Baxter, Conine, and Tamarkin found insignificant systematic risk for wheat, corn, and soybean futures using this composite index. These results were supported by So (1987), who used data on these same commodities for 1953–1976. Elam and Vaught (1988) used a composite index of 90% S&P 500 and 10% Dow–Jones commodity index to analyze betas for cattle and hog futures. They found small but significant systematic risk for these commodities.

Chang, Chen, and Chen (1990) examined copper, platinum, and silver over the period 1964–1983 using a composite index composed of 90% value weighted CRSP (Center for Research in Securities Prices) and 10% Dow–Jones commodity index. They found positive returns and betas for each commodity. By regressing returns on the commodity futures against the estimated betas for the corresponding commodity, Chang, Chen, and Chen also found a positive (but generally not significant) relationship between return and systematic risk.[3] Junkus (1991) analyzed 20 commodities for the ten-year period, January 1978 through December 1987. While her analysis focused on skewness, Junkus also reported results pertinent to systematic risk for three market indexes (100% S&P 500; 93.7% S&P 500 + 6.7% wholesale price index for farm products (WPI); and 100% WPI). Junkus also split her time period into 2 five-year subperiods, and computed betas against the three indexes for the 2 subperiods. She showed that the beta estimates differ by time period, but differ little depending on the index used. For example, the betas for grains were generally significantly greater than zero for 1978–1982 for all three indexes, but the betas for these same commodities were generally not significantly different from zero for the latter period, 1983–1987, no matter which index she used. These results suggest that the time period examined may be much more important than the particular market index employed, and indicate that using a longer time period may help to secure more stable estimates of systematic risk.

DATA AND METHODOLOGY

Data for this study are from Tick Data, Inc., a commercial vendor of futures data, and consist of daily settlement prices for futures contracts on 45 commodities. Individual contracts expired during the years from 1969–1992. Table I shows the commodities analyzed, the number of con-

[3]One unique feature of the study by Chang, Chen, and Chen is the creation of an artificial time series of futures returns as a weighted average of actual futures prices. This innovation is designed to hold maturity constant, instead of using an actual futures contract that might have monthly returns that are both distant and near to the maturity of the futures contract. This methodological feature may account for their unusually strong finding of systematic risk and compensating return.

TABLE I

Data Used in the Analysis

Commodity Type	*Number of Contracts*	*Number of Daily Observations*
Grains and Oilseeds		
Wheat–Chicago	150	18,631
Wheat–Kansas City	83	10,397
Wheat–Winnipeg	64	7,502
Wheat–Minneapolis	60	7,472
Soybean	210	26,121
Soybean oil	241	29,937
Soybean meal	241	29,968
Corn	150	18,631
Oats	150	18,557
Barley	63	7,410
Flaxseed	59	6,981
Rapeseed	59	6,913
Rye	58	6,849
Rough rice	33	4,100
Total	1621	199,469
Other Agricultural		
Cocoa	150	18,340
Coffee	98	12,038
Sugar	160	19,234
Orange juice	153	18,669
Cotton	150	18,391
Lumber	114	14,357
Total	825	101,029
Animals		
Feeder cattle	148	18,358
Live cattle	171	21,210
Live hog	161	20,168
Pork bellies	141	17,358
Total	621	77,094
Energy		
Crude oil	113	13,248
Heating oil	156	19,306
Unleaded gas	93	11,381
Liquid propane	62	6,712
Total	424	50,647
Metals		
Gold	106	13,250
Silver	160	19,636
Palladium	63	7,750
Platinum	98	12,023
Copper	185	22,549
Total	612	75,208
Stock index		
S&P 500	42	5,272
Major market	17	1,695
NYSE composite	42	3,265
Total	101	12,232

TABLE I (Continued)

Data Used in the Analysis

Commodity Type	*Number of Contracts*	*Number of Daily Observations*
Interest rate		
Eurodollar	42	5,309
T-bill	68	8,548
T-bond	60	7,544
Total	170	21,401
Currencies		
Australian dollar	23	2,774
British pound	70	8,820
Canadian dollar	64	8,030
Deutsche mark	70	8,817
Japanese yen	64	8,017
Swiss franc	70	8,818
Total	361	45,276

tracts included in the study for each commodity, and the number of daily settlement price observations available for each commodity. Because futures markets have grown so considerably in recent years, the study includes more observations from the recent past. For example, energy futures and some precious metal futures were not traded at the beginning of the period analyzed in this study. For each contract included in the study, data are drawn from the six months preceding the expiration month for the contract. For most commodities, open interest is low and trading volume is thin in periods distant from maturity. In such cases, settlement prices may be "stale" when they represent actual trade prices; and, in other instances, settlement prices may be determined by the settlement committee rather than by the pure interplay of market forces. Settlement prices in the delivery month may have their own difficulties. As a futures contract comes to expiration, trading volume typically falls as traders close their positions to avoid making or taking delivery. In such thin markets, settlement prices may not represent actual market prices. To avoid these problems of thin markets and potentially unrepresentative prices, this study uses only data for the six months preceding the delivery month, yielding approximately 120 to 123 days of data per contract.

The proxy for the market used in this study is the value-weighted daily return series provided by the Center for Research in Security Prices (CRSP) of the University of Chicago. As the summary of previous studies indicates, conclusions regarding systematic risk are quite robust relative to the market proxy employed.[4]

The concept of return for a futures position has long been problematic because a futures position requires no investment. Following a long tradition, this study defines the daily futures return, F_t, as the percentage change in the settlement price from day $t - 1$ to day t:

$$F_t = \left(\frac{S_t}{S_{t-1}}\right) - 1 \qquad (1)$$

where S_t is the settlement price on the futures contract on day t. These futures returns, combined with the CRSP market return, form the data set on which all analyses are performed.

As has been well documented, futures returns are not distributed normally. Stevenson and Bear (1970) found that distributions of futures returns were leptokurtic for corn and soybeans. Dusak (1973) prepared normal probability plots for the several commodities she analyzed and concluded that the returns were not normally distributed. Mann and Heifner (1976) conclude that futures returns are non-normal and appear to be stable Paretian. Helms and Martell (1985) examined wheat, corn, GNMA, and T-bond futures and found that neither futures returns nor the logs of futures returns were normally distributed. They concluded that either the generating function varies over time or that the returns distribution may best be characterized as a mixture of distributions. These briefly summarized conclusions are characteristic of a literature that is becoming voluminous. The following studies all agree that futures returns are not distributed normally: Stevenson and Bear (1970); Dusak (1973); Clark (1973); Mann and Heifner (1976); Tauchen and Pitts (1983); Cornew, Town, and Crowson (1984); Helms and Martell (1985); Gordon (1985); Hudson, Leuthold, and Sarassoro (1987); So (1987); Hall Brorsen, and Irwin (1989); and Gribbin, Harris, and Lau (1992). In addition to the non-normality of futures returns, there may also be a problem with serial correlation in daily futures returns. This serial correlation could potentially affect the results of regression studies.

Faced with the overwhelming evidence of non-normality of futures returns and potential difficulties with serial correlation of daily futures returns, a total reliance on conventional parametric statistical tests is inappropriate. Therefore, this study not only presents parametric tests of

[4]While findings regarding systematic appear to be quite robust across alternative market proxies, this remains an issue requiring further study. This study employs the CRSP index as it is a research standard and the goal of this article is to provide baseline results employing a consistent methodology across all commodities.

each hypothesis to be examined, but also considers appropriate nonparametric tests of companion hypotheses.

Previous authors have found widely different mean returns for futures contracts. For example, Dusak reported that the commodities she analyzed had zero, or near zero, returns, while Bodie and Rosansky found that 22 of the 23 commodities they considered had positive returns, even though these were generally not significant. This study computes the mean daily percentage return across all available observations for each commodity, and tests these returns for their central tendency. First, the study reports the results of a conventional t-test of the hypothesis that the mean daily percentage return for all observations available for a given commodity equals zero. Second, the study tests whether the median return for all observations available is zero using the Wilcoxon signed-rank test.

To examine the systematic risk of futures contracts, the following regression is performed for each contract, j, available for each commodity:

$$F_{j,t} = a_j + \beta_j R_t + \varepsilon_j \tag{2}$$

where $F_{j,t}$ is the futures return for the jth contract on day t as previously defined, and R_t is the return on the CRSP value-weighted index for day t. The null hypothesis that $\beta_j = 0$ is tested for each contract using a conventional t-test. The same null hypothesis is tested using the nonparametric Theil test.

The third hypothesis examined in this article concerns the relationship between returns achieved on the futures contract and the degree of systematic risk inherent in holding the futures position. As a central tenet of the CAPM, one would expect a higher degree of realized returns to be associated with greater systematic risk. This hypothesis is tested by computing the mean daily return for each futures contract and regressing this mean return against the beta for that contract:

$$\bar{F}_j = \gamma_0 + \gamma_1 \beta_j + \eta \tag{3}$$

Under the null hypothesis of no relationship between the returns on a futures contracts and the systematic risk of the contract, $\gamma_1 = 0$. This null hypothesis is tested with the conventional t-test as well as the nonparametric Theil test.

EMPIRICAL RESULTS

Statistics in Table II present tests of the hypothesis that the mean return on futures contracts is zero. The first column of numbers in Table II

TABLE II

Mean Return

Commodity	Mean Return (Percent per Day)	Mean Return (Percent per Year)	t-Statistic	Wilcoxon Signed-Rank Test
Grains and Oilseeds				
Wheat–Chicago	−0.000559	−0.1397	−0.0494	−0.3124
Wheat–Kansas City	−0.007945	−1.9666	−0.6642	−0.2951
Wheat–Winnipeg	0.000253	0.0633	0.0163	−0.5283
Wheat–Minneapolis	−0.016610	−4.0678	−1.2790	−1.8183
Soybean	0.019349	4.9556	1.8124	−0.6051
Soybean oil	0.039170	10.2858	3.1256[a]	−1.8558
Soybean meal	0.030679	7.9702	2.8741[a]	−2.5840[a]
Corn	0.000971	0.2430	0.0958	−0.4925
Oats	−0.010807	−2.6656	−0.9740	−1.6502
Barley	−0.047589	−11.2193	−3.1215[a]	−3.3820[a]
Flaxseed	−0.038997	−9.2907	−2.2534[a]	−2.4380[a]
Rapeseed	−0.030581	−7.3615	−1.9191	−2.6244[a]
Rye	−0.071319	−16.3360	−4.1358[a]	−3.6660[a]
Rough rice	0.013006	3.3047	0.3453	−0.6522
Other agricultural				
Cocoa	0.011801	2.9939	0.7020	−0.1323
Coffee	0.016979	4.3356	0.7839	−0.2675
Sugar	−0.033303	−7.9897	−1.2930	−1.4771
Orange juice	0.038523	10.1077	2.6986[a]	−1.8971
Cotton	0.026931	6.9635	2.2739[a]	−1.3800
Lumber	−0.012735	−3.1338	−1.0930	−0.5188
Animals				
Feeder cattle	0.008386	2.1185	0.9546	−1.5563
Live cattle	0.028281	7.3252	4.3478[a]	−4.2200[a]
Live hog	0.044399	11.7364	4.0354[a]	−3.5723[a]
Pork bellies	−0.006232	−1.5460	−0.4154	−0.2171
Energy				
Crude oil	0.030022	7.7932	1.6879	−2.3850[a]
Heating oil	0.018663	4.7758	1.5112	−1.7924
Unleaded gas	0.060746	16.3950	3.2965[a]	−4.0864[a]
Liquid propane	0.078408	21.6458	2.1293[a]	−0.9009
Metals				
Gold	−0.011842	−2.9174	−0.8535	−1.6941
Silver	−0.007617	−1.8863	−0.4579	−2.0359[a]
Palladium	0.004454	1.1197	0.1667	−0.1232
Platinum	−0.000694	−0.1733	−0.0435	−0.4979
Copper	0.042299	11.1518	3.1671[a]	−2.5619[a]
Stock index				
S&P 500	0.043838	11.5800	3.7081[a]	−3.2197[a]
Major market	0.017994	4.6008	0.5078	−0.9231
NYSE composite	0.041748	10.9986	3.5204[a]	−3.0947[a]

TABLE II (Continued)

Mean Return

Commodity	Mean Return (Percent per Day)	Mean Return (Percent per Year)	t-Statistic	Wilcoxon Signed-Rank Test
Interest rate				
Eurodollar	0.008738	2.2085	3.9720[a]	−3.4448[a]
T-bill	0.002950	0.7402	1.5310	−2.0347[a]
T-bond	0.009455	2.3918	0.9992	−1.0306
Currencies				
Australian dollar	0.027430	7.0972	2.1895[a]	−2.0074[a]
British pound	0.006336	1.5965	0.6698	−0.6116
Canadian dollar	0.000177	0.0442	0.0561	−0.0936
Deutsche mark	0.001256	0.3144	0.1358	−0.3189
Japanese yen	0.010884	2.7583	1.1348	−1.0834
Swiss franc	−0.000061	−0.0154	−0.0058	−0.1083

[a]Significant at 0.05 level.

shows the mean percentage return per day for all contracts for each commodity for the entire time period of the analysis. The second column of figures shows the mean percentage return per year, assuming 250 trading days per year. Thus, the second column of figures can be computed directly from the first.[5] The third column of figures, labeled "t-statistic," presents the result of a simple t-test of the null hypothesis that the mean return across contracts for a given commodity is zero. An "a" indicates t-values that are significantly different from zero at the 5% significance level in a two-tailed test. The final column of Table II presents the results of the Wilcoxon signed-rank test of the null hypothesis that the median return for each contract is zero. The "a" indicates rejection of the null hypothesis of a zero median at a significance level of 5% in a two-tailed test.[6]

Table II shows that many commodity returns are nonzero over the lengthy period of this study, and some are dramatically different from zero. For example, among the physical commodities, soybean oil, orange juice, live hogs, unleaded gas, liquid propane, and copper all experience mean annualized returns exceeding 10%, while barley lost more than 11% per year. Focusing on the 33 nonfinancial commodities analyzed in this

[5]For any commodity, the value in the second commodity is found by adding 1.0 to the value in the first column and raising the resulting quantity to the 250th power (consistent with the assumed 250 trading days in a year) and subtracting 1.0 from the result.

[6]In computing all significance levels in this study, the normal approximation to the t-test is used because all sample sizes are large. See Wayne W. Daniel (1991) *Applied Nonparametric Statistics, 2nd Ed.*, Boston: PWS-Kent, for a description of the Wilcoxon signed-rank test.

study, 19 computed mean returns are positive, while 14 commodities have negative mean returns. According to the t-tests that are performed, nine of these 33 commodities have significantly positive mean returns, while three have significantly negative mean returns. Almost two-thirds (21 of 33) of the nonfinancial commodities have mean returns that are not significantly different from zero. Among financial futures, four financial instruments exhibit significantly positive mean returns, while no financial instrument produces a significant negative return. For these futures on physical goods, no simple statement about mean returns does justice to the variety of outcomes shown in Table II. However, the modal result for these commodities is a mean return that is indistinguishable from zero.

Previous claims regarding the central tendency of futures returns have focused on the mean rather than the median. The Wilcoxon signed-rank test pertains directly to the median, and the results in the final column of Table II are broadly consonant with those of the t-tests. Generally, Table II shows significant departures from zero for the median and mean occurring for the same contracts. However, this is not universally the case. Soybean oil, orange juice, cotton, and liquid propane show significant positive mean returns according to the t-test, but the median return for these commodities is indistinguishable from zero according to the Wilcoxon signed-rank test. On the other hand, rapeseed, T-bill, crude oil, and silver futures have median returns different from zero, although the mean return for these futures is not significantly different from zero.

Table III summarizes the more than 4700 estimates of beta based on eq. (2). For each contract available for each commodity, eq. (2) is estimated as described in the second section. The first column of figures in Table III reports the mean estimated beta for each commodity. (The number of betas estimated for each commodity equals the number of contracts shown in Table I.) The second column of figures in Table III presents a t-statistic that indicates whether the mean beta is significantly different from zero. An "a" indicates a significant t-value at the 5% level of significance under a two-tailed test. The third and fourth columns record the minimum and maximum estimated betas for each commodity, indicating the range of estimated betas.

When each beta is estimated for the individual contracts, the t-statistic that is used to test a departure of beta from zero is recorded. The fifth and sixth columns of figures in Table III record the percentage of those estimated betas with t-statistics below -2.0 and above $+2.0$. These values show how frequently betas significantly different from zero are encountered. The seventh column of figures shows the average R^2 for the regressions for each commodity. The final column of Table III shows

TABLE III

Beta

Commodity	Average Beta	t-Test of Average Beta	Minimum Beta	Maximum Beta	Percentage of t-Statistics < −2.0	Percentage of t-Statistics >2.0	Average R^2	Wilcoxon Signed-Rank Test
Grains and oilseeds								
Wheat–Chicago	0.0689	4.3797[a]	−0.5572	0.6623	2.67	13.33	0.0164	−4.4364[a]
Wheat–Kansas City	0.0655	3.6242[a]	−0.4202	0.4716	2.41	19.28	0.0194	−3.8046[a]
Wheat–Winnipeg	0.0417	2.1888[a]	−0.3694	0.4927	3.33	15.00	0.0185	−1.4244
Wheat–Minneapolis	0.0246	1.5110	−0.3366	0.3563	0.00	4.69	0.0110	−2.8710[a]
Soybean	0.0733	4.7678[a]	−0.5808	0.7453	5.71	15.24	0.0208	−4.1894[a]
Soybean oil	0.1104	6.2209[a]	−0.5189	0.9235	1.24	13.28	0.0190	−5.3697[a]
Soybean meal	0.0664	4.3220[a]	−0.6578	0.7367	5.39	11.62	0.0186	−4.2261[a]
Corn	0.0258	1.7898	−0.4614	0.4803	4.67	14.67	0.0191	−1.9428
Oats	0.0811	4.0039[a]	−0.7543	0.7607	4.00	16.67	0.0195	−3.9729[a]
Barley	0.0166	0.6883	−0.3947	0.4571	3.17	12.70	0.0192	−0.5682
Flaxseed	0.0237	0.8939	−0.5118	0.4344	6.78	20.34	0.0235	−0.9058
Rapeseed	0.0853	3.5197[a]	−0.2788	0.6192	5.08	22.03	0.0282	−3.0343[a]
Rye	0.0326	1.3011	−0.5052	0.5403	5.17	10.34	0.0187	−1.2581
Rough rice	0.0465	2.3862[a]	−0.2855	0.2953	0.00	6.06	0.0080	−2.4926[a]
Other agricultural								
Cocoa	0.1168	4.8571[a]	−1.1174	0.9368	2.00	10.67	0.0153	−4.7535[a]
Coffee	0.0391	1.8996	−0.4779	0.6892	6.12	1.02	0.0100	−2.6559[a]
Sugar	0.1527	4.4894[a]	−1.2605	1.4624	2.50	8.75	0.0130	−4.7447[a]
Orange juice	0.0222	1.1140	−1.6049	0.5082	2.61	5.23	0.0096	−2.6129[a]
Cotton	0.0525	3.5907[a]	−0.5231	0.6848	2.67	13.33	0.0158	−3.6840[a]
Lumber	0.3128	12.4142[a]	−0.4815	1.3141	1.75	52.63	0.0493	−8.4751[a]
Animals								
Feeder cattle	0.0460	4.4524[a]	−0.4392	0.3498	1.35	12.16	0.0145	−5.1666[a]
Live cattle	0.0276	2.9680[a]	−0.3362	0.2885	0.58	11.70	0.0137	−3.2400[a]
Live hog	0.0323	2.1274[a]	−0.4370	0.5405	3.11	8.07	0.0115	−2.0077[a]
Pork bellies	−0.0191	−0.8194	−0.7650	0.5876	2.13	4.96	0.0105	−0.6061[a]
Energy								
Crude oil	−0.2140	−4.0425[a]	−2.3550	0.4159	16.81	1.77	0.0282	−1.9839[a]
Heating oil	−0.1144	−3.0052[a]	−2.1924	0.6555	12.82	8.33	0.0308	−0.4671

TABLE III (Continued)

Beta

Commodity	*Average Beta*	*t-Test of Average Beta*	*Minimum Beta*	*Maximum Beta*	*Percentage of t-Statistics < −2.0*	*Percentage of t-Statistics >2.0*	*Average R^2*	*Wilcoxon Signed-Rank Test*
Unleaded gas	−0.2032	−3.9421[a]	−2.0646	0.4414	13.98	2.15	0.0292	−2.9714[a]
Liquid propane	−0.3095	−4.4208[a]	−2.1052	0.3354	16.13	0.00	0.0332	−4.2732[a]
Metals								
Gold	0.0481	1.2302	−1.0020	1.1040	27.36	26.42	0.0532	−0.7297
Silver	0.0730	2.0775[a]	−1.2062	1.5631	15.63	18.75	0.0338	−1.4720
Palladium	0.0852	1.3145	−1.1626	1.6074	19.05	20.63	0.0389	−0.9653
Platinum	0.0950	2.0761[a]	−0.8917	1.4625	15.31	21.43	0.0368	−1.5007
Copper	0.1460	6.0805[a]	−0.9441	1.3428	4.86	24.32	0.0330	−6.1241[a]
Stock index								
S&P 500	1.1803	80.0618[a]	1.0248	1.5015	0.00	100.00	0.8743	−5.6454[a]
Major market	1.1519	38.6037[a]	0.9630	1.4094	0.00	100.00	0.8382	−3.6214[a]
NYSE composite	1.1900	74.4208[a]	1.0366	1.4687	0.00	100.00	0.8717	−5.6454[a]
Interest rate								
Eurodollar	0.0439	9.4152[a]	0.0036	0.1179	0.00	73.81	0.1136	−5.6454[a]
T-bill	0.0417	8.4025[a]	−0.0151	0.1573	1.47	58.82	0.0763	−6.7764[a]
T-bond	0.3606	17.7656[a]	0.0954	0.6961	0.00	96.67	0.1720	−6.7359[a]
Currencies								
Australian dollar	−0.0493	−3.2605[a]	−0.2050	0.1667	0.00	0.00	0.0115	−3.0111[a]
British pound	0.0189	1.0750	−0.2873	0.4190	15.71	12.86	0.0297	−1.0212
Canadian dollar	0.0275	5.3218[a]	−0.0492	0.1269	0.00	17.19	0.0176	−4.4405[a]
Deutsche mark	0.0244	1.2048	−0.3333	0.4254	18.57	25.71	0.0385	−1.2026
Japanese yen	0.0162	0.7991	−0.3582	0.3047	20.31	23.44	0.0378	−1.0098
Swiss franc	0.0173	0.7095	−0.4884	0.4951	21.43	21.43	0.0408	−0.7344

[a]Significant at 0.05 level.

Wilcoxon signed-rank statistic testing whether the median beta for each commodity equals zero.

For the 33 physical commodities, Table III indicates a high frequency of significantly positive mean betas. Among "Grains and Oilseeds," 9 of 14 commodities have significantly positive mean betas; 4 of 6 "Other Agricultural" commodities have significantly positive mean betas; 3 of 4 "Animals" have significantly positive mean betas; and 3 of 5 "Metals" exhibit significantly positive mean betas. All significantly negative mean betas are concentrated in the energy sector, where all four "Energy" commodities have significantly negative mean betas. Across all 33 physical commodities, there are 18 significantly positive mean betas and only 4 significantly negative mean betas. For 11 commodities, mean betas are statistically indistinguishable from zero. Excluding the energy sector, the hypothesis that futures betas are negative on average can be rejected.

While the occurrence of statistically significant positive mean betas is common, an examination of the size of the estimated betas and the R^2 statistics undermines the initial impression that physical commodities exhibit positive betas. Among all 33 physical commodities examined, only 5 commodities (soybean oil, cocoa, sugar, lumber, and copper) have mean betas exceeding 0.10. Only sugar and lumber have mean betas exceeding 0.15, and only the mean beta of lumber exceeds 0.2. While the mean betas reported in Table III may be positive, they are small, particularly compared with typical equity betas. Further, significantly positive betas are relatively rare for most commodities. For example, among all physical commodities, only lumber and gold have more than 25% significantly positive estimated betas. For all physical commodities (excluding metals) more than 80% of estimated betas are insignificantly different from zero. Betas for metals are often different from zero, but tend to have some contracts with significantly positive betas and some with significantly negative betas.

The mean beta across all physical commodities is 0.0463. Excluding the energy commodities, which all have negative mean betas, the average for the physical commodities is still only 0.0734. For the financials, the mean beta is 0.2395, mainly reflecting the quite large betas for stock index futures. Thus, for physical commodities, betas are generally minuscule—about 0.05.

The R^2 statistics reported in Table III support the conclusion that systematic risk is not an important determinant of futures returns. For all physical commodities, the average R^2 is less than 6%. Across all commodities in the "Grains and Oilseeds," the "Other Agricultural," and "Animals," the average R^2 is less than 2%. The average R^2 across "Energy" and "Metal" commodities is less than 4%.

For financial futures, systematic risk is often much stronger, but varies across the types of instruments. First, the "Stock Index" futures, not surprisingly, show mean betas greater than 1.0, with all estimated betas being significantly positive and R^2 values in the range of 85%. For interest rate futures, all mean betas are significantly positive. However, for the short-term debt instruments (T-bills and Eurodollars) mean betas are small, less than 0.05. For T-bond futures, however, the mean beta is 0.36, and almost all of the betas estimated for T-bond futures are significantly positive. Among the six currency futures considered, the mean beta of the Australian dollar is significantly negative, while the mean beta for the Canadian dollar is significantly positive. All other mean betas are indistinguishable from zero. The average R^2 for the Australian and Canadian dollars are both less than 2%. These results suggest that currency futures, as a group, have little systematic risk.

To provide additional perspective, it is useful to compare the results presented in Table III with the conclusions reached by Dusak (1973) and Bodie and Rosansky (1980). Dusak (1970) found mean betas of 0.0602 for wheat, 0.0410 for corn, and 0.0730 for soybeans. From Table III in this study, the average betas are 0.0689 for wheat, 0.0258 for corn, and 0.0733 for soybeans. Dusak found each of her 16 regression coefficients across the commodities to be insignificantly different from zero, while Table III shows about 82% of the 510 regressions estimated for these commodities to have coefficients indistinguishable from zero. Thus, the results in Table III are highly consistent with Dusak's conclusions. Bodie and Rosansky estimated betas for most commodities were negative, but not significantly different from zero. Only broilers and sugar had significant (and negative) betas. Compared with the results of Bodie and Rosansky, Table III is generally consistent, but shows a more frequent tendency to find positive betas. This difference may by due to the difference in time period considered and to the many more observations that underlie Table III.

Table IV substantiates and extends the conclusions of Table III. Table IV presents the distribution of estimated betas for each commodity by showing the percentage of estimated betas in various ranges. The overwhelming bulk of betas estimated for physical commodities lies between -0.10 and 0.10. For example, 42% of the estimated betas for Chicago wheat lie in the range from -0.10 to 0.10. For the physical commodities, the following list shows the percentage of estimated betas lying between -0.10 and 0.10 and the percentage lying between -0.30 and 0.30. For

TABLE IV

Distribution of Betas Percentage of Estimated Betas in Range by Commodity

Commodity	<= −0.9	(−0.9, −0.7]	(−0.7, −0.5]	(−0.5, −0.3]	(−0.3, −0.1]	(−0.1, 0.1]	(0.1, 0.3]	(0.3, 0.5]	(0.5, 0.7]	(0.7, 0.9]	>= 0.9
Grains and oilseeds											
Wheat–Chicago	0.00	0.00	0.67	3.33	12.67	42.00	30.67	8.67	2.00	0.00	0.00
Wheat–Kansas City	0.00	0.00	0.00	2.41	12.05	46.99	31.33	7.23	0.00	0.00	0.00
Wheat–Winnipeg	0.00	0.00	0.00	3.13	14.06	59.38	20.31	3.13	0.00	0.00	0.00
Wheat–Minneapolis	0.00	0.00	0.00	3.33	8.33	63.33	18.33	6.67	0.00	0.00	0.00
Soybean	0.00	0.00	0.48	2.38	19.52	36.67	26.19	10.95	2.86	0.95	0.00
Soybean oil	0.00	0.00	1.24	3.32	19.09	27.80	24.48	14.11	7.88	1.66	0.41
Soybean meal	0.00	0.00	0.41	6.64	15.35	36.51	26.97	9.54	3.32	1.24	0.00
Corn	0.00	0.00	0.00	3.33	17.33	48.67	24.00	6.67	0.00	0.00	0.00
Oats	0.00	0.67	0.00	8.00	12.00	33.33	30.00	12.00	3.33	0.67	0.00
Barley	0.00	0.00	0.00	4.76	26.98	38.10	23.81	6.35	0.00	0.00	0.00
Flaxseed	0.00	0.00	1.69	5.08	16.95	42.37	25.42	8.47	0.00	0.00	0.00
Rapeseed	0.00	0.00	0.00	0.00	16.95	37.29	32.20	11.86	1.69	0.00	0.00
Rye	0.00	0.00	1.72	0.00	25.86	31.03	31.03	8.62	1.72	0.00	0.00
Rough rice	0.00	0.00	0.00	0.00	9.09	63.64	27.27	0.00	0.00	0.00	0.00
Other agricultural											
Cocoa	0.67	0.00	1.33	4.67	16.00	23.33	28.00	18.67	4.00	2.67	0.67
Coffee	0.00	0.00	0.00	8.16	9.18	45.92	27.55	8.16	1.02	0.00	0.00
Sugar	2.50	0.63	2.50	6.25	10.63	24.38	20.00	14.38	9.38	5.63	3.75
Orange juice	0.65	1.31	0.65	3.27	12.42	44.44	28.76	7.84	0.65	0.00	0.00
Cotton	0.00	0.00	0.67	2.00	10.00	49.33	33.33	2.67	2.00	0.00	0.00
Lumber	0.00	0.00	0.00	1.75	2.63	10.53	39.47	24.56	14.91	2.63	3.51
Animals											
Feeder cattle	0.00	0.00	0.00	1.35	8.78	58.78	28.38	2.70	0.00	0.00	0.00
Live cattle	0.00	0.00	0.00	1.17	13.45	57.89	27.49	0.00	0.00	0.00	0.00
Live hog	0.00	0.00	0.00	5.59	17.39	42.24	25.47	7.45	1.86	0.00	0.00
Pork bellies	0.00	1.42	2.84	11.35	22.70	24.82	23.40	10.64	2.84	0.00	0.00
Energy											
Crude oil	14.16	0.88	0.00	1.77	17.70	42.48	19.47	3.54	0.00	0.00	0.00
Heating oil	8.33	2.56	1.28	3.85	17.95	32.69	27.56	4.49	1.28	0.00	0.00
Unleaded gas	10.75	3.23	3.23	3.23	18.28	45.16	11.83	4.30	0.00	0.00	0.00
Liquid propane	14.52	1.61	4.84	11.29	11.29	46.77	8.06	1.61	0.00	0.00	0.00

TABLE IV (Continued)

Distribution of Betas Percentage of Estimated Betas in Range by Commodity

Commodity	<= −0.9	(−0.9, −0.7]	(−0.7, −0.5]	(−0.5, −0.3]	(−0.3, −0.1]	(−0.1, 0.1]	(0.1, 0.3]	(0.3, 0.5]	(0.5, 0.7]	(0.7, 0.9]	>= 0.9
Metals											
Gold	0.94	0.00	5.66	13.21	22.64	17.92	10.38	16.04	7.55	2.83	2.83
Silver	1.25	0.00	5.63	10.63	16.25	26.25	12.50	12.50	7.50	3.75	3.75
Palladium	3.17	0.00	4.76	7.94	23.81	17.46	9.52	14.29	6.35	6.35	6.35
Platinum	0.00	3.06	2.04	11.22	21.43	17.35	17.35	12.24	5.10	4.08	6.12
Copper	0.54	1.08	2.16	3.24	8.11	29.19	25.41	18.38	7.57	2.70	1.62
Stock index											
S&P 500	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Major market	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
NYSE composite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Interest rate											
Eurodollar	0.00	0.00	0.00	0.00	0.00	92.86	7.14	0.00	0.00	0.00	0.00
T-bill	0.00	0.00	0.00	0.00	0.00	88.24	11.76	0.00	0.00	0.00	0.00
T-bond	0.00	0.00	0.00	0.00	0.00	1.67	33.33	46.67	18.33	0.00	0.00
Currencies											
Australian dollar	0.00	0.00	0.00	0.00	8.70	86.96	4.35	0.00	0.00	0.00	0.00
British pound	0.00	0.00	0.00	0.00	20.00	51.43	25.71	2.86	0.00	0.00	0.00
Canadian dollar	0.00	0.00	0.00	0.00	0.00	90.63	9.38	0.00	0.00	0.00	0.00
Deutsche mark	0.00	0.00	0.00	2.86	17.14	45.71	31.43	2.86	0.00	0.00	0.00
Japanese yen	0.00	0.00	0.00	3.13	18.75	46.88	29.69	1.56	0.00	0.00	0.00
Swiss franc	0.00	0.00	0.00	5.71	21.43	42.86	21.43	8.57	0.00	0.00	0.00

all groups of physical commodities except metals, 33 to 47% of all estimated betas lie in the range from −0.10 to 0.10. Among the metals, about 25% of the estimated betas lie in the range of −0.10 to 0.10. For the physical commodity groups other than metals, 72 to 88% of the estimated betas lie in the range from −0.30 to 0.30, while 56.37% of the metals betas lie in this range. Thus, the distributions reported in Table IV are summarized in the listing below. For the nonmetal physical commodities, the distribution shows that most betas are quite small, with about 80% having an absolute value less than 0.3. For the metals, fewer betas lie in these narrow ranges. As Table IV shows, metals betas are quite dispersed. However, the average betas for each metal are close to zero, as reported in Table III. Stock index futures represent a special case, with all estimated betas exceeding 1.0. Interest rate futures have betas that are near zero, but there is a substantial difference between long-maturity and short-maturity instruments as already noted. Currency futures have a tight, symmetrical distribution of estimated betas with 57.06 lying between −0.10 and 0.10 and about 95% lying between −0.30 and 0.30.

	Percentage of Estimated Betas in the Range	
Commodity Group	*−0.10 to 0.10*	*−0.30 to 0.30*
Grains and oilseeds	39.67	82.73
Other agricultural	33.09	72.73
Animals	46.54	88.25
Energy	40.09	76.17
Metals	23.37	56.37
Stock index	0.00	0.00
Interest rate	58.82	77.06
Currencies	57.06	94.74

The evidence of Tables III and IV, along with the preceding summary listing, show that estimated betas for most physical commodities are generally near zero. This conclusion is based largely on parametric tests that presume a normal distribution of underlying returns. As shown, this presumption is unwarranted. Accordingly, Table V summarizes results of the nonparametric Theil test of the hypothesis that the beta estimated by eq. (2) is equal to zero. The Theil test provides a distribution-free test of the null hypothesis that $\beta = 0$. The Theil test employs the Kendall tau statistic. When sample sizes are large, as they are in each instance in this study, the tau statistic is distributed approximately N(0,1).[7] The Theil test is performed for each of the regressions in this study, and Table V sum-

[7]See Theil (1950) and Daniel (1990) pp. 435–438.

TABLE V

Theil Test of Hypothesis That Beta Equals Zero

	Percentage of Betas		
Commodity	*Significantly Greater Than Zero*	*Significantly Less Than Zero*	*Not Significantly Different From Zero*
Grains and oilseeds			
Wheat–Chicago	12.40	0.00	87.60
Wheat–Kansas City	16.87	1.20	81.93
Wheat–Winnipeg	6.25	1.56	92.19
Wheat–Minneapolis	9.84	3.28	86.89
Soybean	15.38	3.55	81.07
Soybean oil	11.34	2.58	86.08
Soybean meal	14.43	2.06	83.51
Corn	16.53	0.83	82.64
Oats	17.39	1.09	81.52
Barley	10.94	0.00	89.06
Flaxseed	15.00	5.00	80.00
Rapeseed	16.67	3.33	80.00
Rye	10.17	1.69	88.14
Rough rice	2.94	0.00	97.06
Other agricultural			
Cocoa	12.90	3.23	83.87
Coffee	3.03	5.05	91.92
Sugar	9.01	0.00	90.99
Orange juice	5.79	2.48	91.74
Cotton	16.67	0.00	83.33
Lumber	50.43	0.87	48.70
Animals			
Feeder cattle	9.45	0.79	89.76
Live cattle	6.60	1.89	91.51
Live hog	6.21	1.86	91.93
Pork bellies	4.35	2.61	93.04
Energy			
Crude oil	0.00	12.28	87.72
Heating oil	10.90	8.97	80.13
Unleaded gas	3.19	12.77	84.04
Liquid propane	0.00	14.52	85.48
Metals			
Gold	22.43	24.30	53.27
Silver	19.83	11.57	68.60
Palladium	17.07	12.20	70.73
Platinum	19.75	11.11	69.14
Copper	29.25	0.94	69.81
Stock index			
S&P 500	100.00	0.00	0.00
Major market	100.00	0.00	0.00
NYSE composite	100.00	0.00	0.00

TABLE V (Continued)

Theil Test of Hypothesis That Beta Equals Zero

Commodity	Percentage of Betas: Significantly Greater Than Zero	Significantly Less Than Zero	Not Significantly Different From Zero
Interest rate			
Eurodollar	81.40	0.00	18.60
T-bill	66.18	0.00	33.82
T-bond	95.08	0.00	4.92
Currencies			
Australian dollar	4.17	8.33	87.50
British pound	11.27	15.49	73.24
Canadian dollar	12.50	0.00	87.50
Deutsche mark	16.90	15.49	67.61
Japanese yen	17.19	17.19	65.63
Swiss franc	19.72	21.13	59.15

marizes the results of these Theil tests. For each commodity, Table V shows the proportions of estimated betas that are significantly greater than zero, significantly less than zero, and not significantly different from zero. In general, the Theil tests support the conclusions of Tables III and IV as already discussed. However, the Theil tests generally find fewer rejections of the null hypothesis that $\beta = 0$. This is not surprising, as the t-tests reported in Table III are more powerful than nonparametric tests. Nonetheless, the t-tests presume a normality of futures returns that is false. Thus, the Theil test, as a nonparametric test, is able to reject the null hypothesis of a zero beta with less frequency. As Table V shows, for "Grains and Oilseeds," 80 to 97% of betas estimated for individual commodities are not significantly different from zero. Failure to reject the null hypothesis that $\beta = 0$ ranges from 49 to 92% for "Other Agricultural," from 90 to 93% for "Animals," from 80 to 87% for "Energy," and from 53 to 71% for "Metals." As Table V also shows, betas for stock indexes and interest rate futures are generally significantly greater than zero. For "Currencies," from 59 to 88% of the estimated betas are not significantly different from zero.

The results of the Theil tests reported in Table V, along with the estimates of Table III, and the distributions recorded in Table IV, show that betas for physical commodities are generally quite close to zero. While this overall conclusion appears to be fully supported by the evidence, important differences among commodities do exist. For example, lumber appears to have a potentially economically significant positive beta, with an average estimated beta exceeding 0.3. By contrast, energy futures have negative mean betas in the range of -0.20 to -0.31. Average estimated betas for metals are generally quite small, but the distribution of estimated betas exhibits considerable variance. For gold, almost 20% of estimated betas are less than -0.30 and almost 30% exceed 0.30. Nonetheless, the average beta for gold is only 0.0481, which is not significantly different from zero, and 54% of the estimated betas do not significantly differ from zero. Thus, while betas for physical commodities may be near zero as a general rule, important differences and exceptions do exist.

Table VI tests the third hypothesis, the relationship between returns and estimated systematic risk, by estimating eq. (3) for each commodity. Table VI includes six columns of figures. The first column reports estimates for the intercept in eq. (3), while the second column reports the results of a t-test for the null hypothesis $\gamma_0 = 0$. Columns three and four report the estimated slope coefficient (γ_1) and a test of the null hypothesis that $\gamma_1 = 0$. The fifth column reports the R^2 for the regression, and the final column presents the Theil test statistic providing a nonparametric test of the hypothesis that $\gamma_1 = 0$.

According to the CAPM, one would expect a generally positive relationship between realized return and the level of systematic risk, which would be evidenced by positive estimated values for γ_1 in eq. (3). Across all 33 physical commodities, there are 24 negative and 9 positive estimated betas. No positive beta is significantly different from zero, while there are 11 significantly negative values for γ_1. Similar results are found for financial futures. Among 12 instruments, 8 have negative slope estimates, against 4 positive values. Two of the negative coefficients are significantly different from zero, while none of the positive estimated coefficients differ from zero. Across all 45 commodities, including both financial and physical futures, 32 estimated betas are negative, and only 13 are positive. Of all 45 commodities, no positive slope estimate differs significantly from zero, while 13 negative coefficients are significant. Therefore, the results of Table VI provide strong evidence that systematic risk in futures is not rewarded by additional return. Further, there appears to be an inverse relationship between systematic risk and realized return. However, given the low levels of systematic risk in most futures, this negative result for the CAPM must be interpreted with special care. The results of Table VI appear to be quite surprising. However, Bodie and Rosansky (1980) found a similar inverse relationship between realized return and beta.

TABLE VI

The Relationship Between Return and Systematic Risk

Commodity	γ_0	γ_0 *t-Statistic*	γ_1	γ_1 *t-Statistic*	R^1	*Theil Test*
Grains and oilseeds						
Wheat–Chicago	−0.0000	−0.02	−0.0000	−0.08	0.0000	0.3575
Wheat–Kansas City	−0.0001	−0.41	−0.0004	−0.55	0.0037	0.7393
Wheat–Winnipeg	−0.0000	−0.08	0.0006	0.49	0.0039	−2.2305[a]
Wheat–Minneapolis	−0.0002	−1.55	0.0011	1.20	0.0241	−0.9312
Soybean	0.0003	2.67[a]	−0.0014	−2.96[a]	0.0403	2.3684[a]
Soybean oil	0.0004	3.07[a]	−0.0002	−0.48	0.0010	−0.0536
Soybean meal	0.0004	3.81[a]	−0.0016	−3.63[a]	0.0524	3.9881[a]
Corn	0.0000	0.12	−0.0001	−0.20	0.0003	0.6874
Oats	−0.0001	−1.26	0.0005	1.08	0.0078	−0.0601
Barley	0.0005	−3.09[a]	−0.0003	0.33	0.0018	−0.8956
Flaxseed	−0.0004	−2.20[a]	0.0000	0.03	0.0000	−0.0196
Rapeseed	−0.0003	−1.92	0.0004	0.49	0.0042	−1.4975
Rye	−0.0007	−3.92[a]	−0.0005	−0.55	0.0054	−0.0201
Rough rice	−0.0000	−0.07	0.0034	1.00	0.0310	−1.2705
Other agricultural						
Cocoa	0.0002	0.96	−0.0005	−0.85	0.0049	0.4712
Coffee	0.0002	0.82	−0.0003	−0.32	0.0011	0.1657
Sugar	−0.0003	−1.16	−0.0001	−0.14	0.0001	0.1918
Orange juice	0.0004	2.99[a]	−0.0016	−2.81[a]	0.0497	1.5381
Cotton	0.0003	2.76[a]	−0.0013	−1.99[a]	0.0260	1.9386
Lumber	0.0004	2.52[a]	−0.0018	−4.33[a]	0.1434	3.7909[a]
Animals						
Feeder cattle	0.0001	1.06	−0.0003	−0.49	0.0017	−0.5123
Live cattle	0.0003	4.72[a]	−0.0011	−2.05[a]	0.0243	1.9383
Live hog	0.0005	4.04[a]	−0.0003	−0.52	0.0017	0.5175
Pork bellies	−0.0001	−0.44	−0.0003	−0.46	0.0015	0.4741
Energy						
Crude oil	0.0004	1.95	0.0003	1.08	0.0103	−0.1638
Heating oil	0.0002	1.43	−0.0000	−0.15	0.0001	−0.5226
Unleaded gas	0.0006	3.05	0.0000	0.09	0.0001	−2.1971[a]
Liquid propane	0.0002	0.40	−0.0020	−3.22[a]	0.1474	1.9437
Metals						
Gold	−0.0001	−0.53	−0.0010	−2.89[a]	0.0743	3.2350[a]
Silver	0.0000	0.06	−0.0012	−3.24[a]	0.0624	3.5043[a]
Palladium	0.0001	0.25	−0.0003	−0.53	0.0045	1.9691
Platinum	0.0001	0.57	−0.0010	−3.00[a]	0.0859	3.5819[a]
Copper	0.0005	3.73[a]	−0.0008	−2.01[a]	0.0216	3.4283[a]
Stock index						
S&P 500	0.0013	0.90	−0.0008	−0.61	0.0091	−1.1379
Major market	0.0069	2.21[a]	−0.0058	−2.16[a]	0.2379	0.8239
NYSE composite	0.0004	0.27	0.0000	0.03	0.0000	−1.1813

TABLE VI (Continued)

The Relationship Between Return and Systematic Risk

Commodity	γ_0	γ_0 *t-Statistic*	γ_I	γ_I *t-Statistic*	R^I	*Theil Test*
Interest rate						
Eurodollar	0.0000	1.03	0.0011	1.50	0.0530	−0.7478
T-bill	0.0001	2.79[a]	−0.0011	−2.37[a]	0.0783	1.0746
T-bond	−0.0001	−0.33	0.0005	0.79	0.0106	−0.9120
Currencies						
Australian dollar	0.0002	1.40	−0.0011	−0.62	0.0178	0.8187
British pound	0.0001	0.86	−0.0010	−1.51	0.0324	2.6159[a]
Canadian dollar	0.0000	0.51	−0.0006	−0.84	0.0113	1.2109
Deutsche mark	0.0000	0.18	−0.0002	−0.35	0.0018	0.9937
Japanese yen	0.0001	1.00	0.0008	1.28	0.0256	−0.8401
Swiss franc	0.0000	0.03	−0.0002	−0.37	0.0021	1.3942

[a]Significant at 0.05 level.

CONCLUSION

This study examines three key hypotheses regarding the return and risk characteristics of futures returns. The first hypothesis is that the mean returns on futures contracts equals zero. Second, the study tests the null hypothesis that the systematic risk of futures contracts is zero, as evaluated in a CAPM setting. Third, the study tests for the relationship between realized returns and systematic risk. Recognizing the nonnormality of futures returns, this study reports results for both parametric and nonparametric tests. As the nonparametric results support the parametric findings, this summary focuses only on the parametric results.

To examine these three familiar hypotheses, this study uses much more data than any previous study, examining many more commodities, many more observations, and many more contracts. The data set analyzed in this study includes almost 600,000 daily futures price observations for 4735 contracts drawn from 45 commodities, including physical and financial futures traded during the period, 1969–1992.

Among the 33 physical commodities included in the study, mean returns are positive for 19 commodities and negative for 14 commodities. Nine commodities have significantly positive mean returns, while 3 commodities have significantly negative returns. Of these physical commodities, the mean returns for 21 commodities do not differ significantly from zero. Of 12 financial futures, 4 commodities exhibit significantly positive mean returns, while none have significantly negative mean returns. Thus, for physical commodities, returns are generally near zero, but show a greater preponderance of positive means. Financial instruments more often exhibit positive returns.

For the 33 physical commodities included in the study, the mean beta is positive for 18 commodities and negative for only four commodities, and these negative results are peculiar to the energy complex. This left 11 physical commodities with mean betas indistinguishable from zero. Thus, the preponderance of physical commodities have mean betas greater than zero. Even though estimated betas tend to be positive more often than negative, betas for most commodities are quite small. Across all 33 physical commodities, the mean beta is only 0.0463. Further, only five goods (soybean oil, cocoa, sugar, lumber, and copper) have mean betas exceeding 0.10. Only the mean beta of lumber exceeds 0.20. Across all physical commodities, the average R^2 is less than 0.06. Consequently, systematic risk is generally near zero for these physical commodities.

Realized returns on futures are generally inversely related to systematic risk, as measured by regressing return on beta for all contracts for a given commodity. Among the 33 physical commodities, there is no significantly positive relationship. By contrast, there is a significant inverse relationship for 11 of the 33 physical commodities. Similar results hold for financials, with no significantly positive relationship and two significantly negative relationships. Therefore, realized return is not positively related to systematic risk; if anything, the relationship is negative. However, given the very low levels of systematic risk for most commodities, the finding of an inverse relationship between realized return and systematic risk must be interpreted cautiously.

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