Risk and Return in Copper, Platinum, and Silver Futures

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I. INTRODUCTION

The implications of the Keynesian (1930) theory of normal backwardation in the context of the Sharpe (1964) and Lintner (1965) capital asset pricing model (CAPM) have been examined for both agricultural and livestock futures during the last few years. The Keynesian theory asserts that futures prices are volatile and therefore long traders, require a positive risk premium for bearing the price risk. However, from a portfolio theoretical viewpoint, diversifiability should prohibit financial markets rewarding all of the price risks. The Sharpe-Lintner CAPM predicts that only systematic risks of financial assets are rewarded by the financial markets. Whether long futures traders bear any systematic risks and whether there is an average reward commensurable to systematic risks of futures contracts have been studied by Dusak (1973), Carter, Rausser, and Schmitz (1983), Marcus (1984), Baxter, Conine, and Tamarkin (1985), So (1987), and Elam and Vaught (1988), among others.[1] The purpose of this article is to extend the investigations into three major metal futures contracts; copper, platinum, and silver futures.[2]

The characteristics of the underlying commodities of metal futures are quite different in many aspects from those of traditional agricultural and livestock futures. For example, most metals can be stored indefinitely, while holding times for grains, live cattle, and pork bellies are all relatively short. Moreover, metals are not subject to seasonal production. Furthermore, metals traditionally have been regarded as an intrinsic store of wealth. Demand for metals often increases in times of high anticipated inflation, currency depreciation, and/or political instability. In this sense, metals seem to compete with other financial assets as possible instruments investors may use to carry their wealth over time. As spot and futures prices of a commodity tend to follow each other,

We have greatly benefited from the comments of two referees of this journal.
[1]Throughout the article, speculators were assumed to be net long.
[2]Futures in gold is excluded since it has a relatively short trading history.

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it is of particular interest to investigate whether metal futures traders are receiving an average reward which proportionate to the systematic risk of the contract.

II. REVIEW OF LITERATURE RE: CAPM AND FUTURES MARKETS

The one-period *ex ante* Sharpe-Lintner capital asset pricing model has the following form:

$$E(R_i) = R_f + \beta_i[E(R_m) - R_f]. \tag{1}$$

In this expression, $E(.)$ is the expectational operator; R_i is the return on asset i, expressed as a fraction of its initial value; R_f is the return on short-term interest-bearing securities; R_m is the return on the market portfolio of all assets taken together; and the coefficient β_i, defined by $\mathrm{Cov}(R_i, R_m)/\mathrm{Var}(R_m)$, is a measure of the extent to which the risk of asset, i, cannot be diversified away.

The model assumes that the expected return on a financial asset is composed of a risk premium and the return on the risk-free asset, which represents a time premium for the committed capital. The risk premium on a financial asset equals the product of the systematic risk of the asset (β_i) and the risk premium on the market portfolio $[E(R_m) - R_f]$. The intuition behind the risk premium composition is that the holders of any financial assets are compensated only for bearing those risks that cannot be diversified away. Within this context, holders of futures contracts can expect a positive risk premium only if changes in contract prices are not independent of changes in vlaue of all assets combined.

Since β_i's are not observable, researchers have relied upon the market model to estimate the systematic risk[3]:

$$R_{it} - R_{ft} = a_i + b_i(R_{mt} - R_{ft}) + \varepsilon_{it}, \tag{2}$$

where a_i and b_i are regression coefficients and ε_{it} is a disturbance term. In (2), a_i and b_i are estimated by regressing the asset i's historical returns against the excess returns on a proxy for the market portfolio. The slope of the regression line, b_i, then is an estimate of the β_i of the asset. When b_i is found to be significantly nonzero, one rejects the null hypothesis that financial asset i has zero systematic risk. The intercept of the regression line, a_i, has generally been referred to as Jensen's (1968) performance measure for the financial asset. If the model is well-specified, a_i measures the mean excess return to the asset i, forming a legitimate performance measure of the financial asset. When a_i is statistically indistinguishable from zero, one concludes that the financial asset has earned an average premium which is commensurable to its systematic risk.

Either regression specification (2) or a modified version of the specification has been employed to investigate the risk and return for various commodity futures. The most common modification replaces excess returns on the left-hand side of (2) with raw returns. That is

$$R_{it} = a_i + b_i(R_{mt} - R_{ft}) + \varepsilon_{it}. \tag{3}$$

The modification is due to the fact that futures are traded on margin, thus, traders do not require as much compensation for deferred consumption. Studies by Carter, Rausser, and Schmitz (1983, hereafter referred to as CRS) and Elam and Vaught (1988), for example, adopted the modification.[4]

[3]The CAPM is an *ex ante* model. All terms in the model are defined in terms of unobservable parameters. To convert the *ex ante* equation (1) into the regression specification, (2), an assumption of a single-factor return generating process is required. See Jensen (1969) for detailed discussions.

[4]Some studies also allow the estimated systematic risk in (2) to be stochastic. For example, see CRS (1983) and SO (1987).

With agricultural commodity contracts over the period of 1952 through 1967, Dusak (1973) found that the systematic risks and average returns for wheat, corn, and soybeans futures contracts were near zero. She concluded that wheat, corn, and soybeans futures contracts are not risky assets when held as part of a large portfolio of assets. CRS modified Dusak's study by allowing a stochastic systematic risk as a function of actual net speculative positions. By using a combined index consisting of 50% of the Standard and Poor's 500 (S&P 500) stock index and 50% of the Dow-Jones commodity futures index as a proxy for the market portfolio, CRS found that approximately half of the contracts had significantly positive systematic risks.[5]

Baxter, Conine, and Tamarkin (1985, hereafter referred to as BCT) replicated the Dusak study by using a proxy for the market portfolio consisting of 93.7% of the S&P 500 index and 6.3% of the Dow-Jones Cash Commodity Index. Contrary to CRS, BCT found insignificant systematic risks for wheat, corn, and soybeans futures. By using a random coefficient regression coefficient method, So (1987) likewise could not confirm the existence of a positive systematic risk for the same three futures contracts during the period, 1953 through 1976.

The same analysis has been extended by Elam and Vaught (1988) to examine the risk and return in cattle and hog futures. It revealed low, but significant, systematic risks for four cattle and one hog futures contracts. The proxy index employed by them was one with a weight of .9 on the S&P 500 index and .1 on the Dow-Jones Cash Commodity Index.

The data used to asses the characteristics of the risk and return for copper, platinum, and silver commodity futures, along with the results, appear in the following section.

III. DESCRIPTION OF DATA USED IN THIS STUDY

Over the sample period from January 1964 to December 1983, six actively traded futures for copper and silver, along with four for platinum were considered. Table I presents the delivery months and trading markets for these contracts. Monthly-end settlement prices from December 1963 to December 1983 for these sixteen contracts were collected from the *Wall Street Journal.*[6]

Table I
THE STRUCTURE OF METAL FUTURES DATA

Commodity	Delivery Month	Market[a]
Copper	January, March, May, July, September, and December	CMX (Commodity Exchange Inc., N.Y.)
Platinum	January, April, July, and October	NYM (New York Mercantile Exchange)
Silver	January, March, May, July, September, and December	CMX (Commodity Exchange Inc., N.Y.)

[a]Dual trading markets exist for silver, namely CMX and Chicago Board of Trade (CBOT).

[5]The results of CRS were criticized by Marcus (1984) for giving too much weight to commodity prices in the market portfolio. Marcus suggests a weight of .1 for the commodity index.

[6]Monthly-end settlement price is the settlement price on the last trading day of the month. When the settlement price on the last trading day is not available, the settlement price on either one day before, or after, the last trading day as a proxy, is used.

Most return time-series generated for estimating futures' betas in early studies are based on changes in futures prices over time for contracts with a specific delivery month. However, it should be noted that, as a result of the fixed delivery time, the remaining life of each contract changes over time. Thus, each return time-series usually contains both realized returns on a contract with a remaining life of up to one year and as short as one month. Several studies have shown that the systematic risk of an asset with limited life is a function of the remaining life of the asset.[7] Conceivably, failure to fix the maturity of the return time series may reduce the statistical significance of the beta estimates.

In this study, time series price data is generated for artificial futures contracts with a fixed maturity by using a weighted average of two futures quotations for each commodity. For example, in February, September-contract price is viewed as the futures price with seven months to maturity. In March, since no contract matured in October, the seven-month contract price is obtained by weighing the September- and the December-contract prices by 2/3 and 1/3, respectively. This adjustment is similar to that used by Dow Jones & Co. in constructing the futures index that would apply to delivery 150 days later. Similar treatments have been made in Elam and Vaught (1988).

Based on the quotations of the sixteen futures contracts, thirteen fixed maturity price time series are generated. For copper and silver futures, five time series with a fixed maturity of 3-, 5-, 7-, 9-, or 12-month are created. Price time series with a remaining maturity of 4-, 7-, or 10-month are produced for platinum.

The realized return on the contract with a fixed maturity signified by i during period t, R_{it}, is computed as [8]

$$R_{it} = \ln(P_{it}/P_{it-1}), \tag{4}$$

where P_{it} and P_{it-1} are contract i's settlement prices at time t and $t - 1$, respectively. Following Elam and Vaught (1988), a combination of 90% of the return on the value weighted CRSP (Center for Research in Securities Prices) stock index and 10% of the Dow-Jones Cash Commodity Index is used as a proxy for the market portfolio in this study's empirical tests. The end-of-period returns on one-month Treasury-bills are obtained from Ibbotson and Sinquefield (1985) for the same period. These serve as a proxy for the monthly risk-free interest rate.

IV. EMPIRICAL RESULTS

Table II presents the means and standard deviations of monthly returns, as well as the Sharpe performance measures for the thirteen futures contracts during the periods from January 1964 to December 1983 for copper and platinum and from January 1969 to December 1983 for silver, and for two subperiods.[9] The investigation period for silver is shorter, since silver prices were under control at $1.29 per troy ounce before May 1968.[10] Symbolically, Sharpe performance measure, S_i, is calculated as follows:

[7]These studies, in general, analyze the functional relationship between beta and the remaining life of bonds rather than futures. These include the studies by Jarrow (1987) and Boquist, Racette, and Schlarbaum (1975). Nevertheless, only a small effort is needed to generalize these results for futures contracts. Samuelson (1965), on the other hand, shows that the variation of forward prices should be a decreasing function of maturity.

[8]The term rate of return is used loosely here. Definition (3) underestimates the rate of return of trading futures because virtually all futures contracts are traded on margin. See Dusak (1973), for a detailed discussion of this issue.

[9]Portioning sample period into pre-1977 and post-1977 subperiods have been widely adopted in recent years. For example, see Fama and Gibbons (1984), and Chen, Roll, and Ross (1986).

[10]Details on legislated silver prices can be found in Streeter (1984).

Table II

MEANS AND STANDARD DEVIATIONS OF MONTHLY RATES OF RETURNS AND THE SHARPE PERFORMANCE MEASURES FOR FIXED-MATURITY CONTRACTS[a]

Contract	Mean (%)	*SD*[b] (%)	*Si*[c] (%)	Mean (%)	*SD* (%)	*Si* (%)	Mean (%)	*SD* (%)	*Si* (%)
	1964–83			1978–83			1964–77		
Copper:									
3-month	.33	8.17	−2.69	.15	7.94	−8.65	.41	8.28	−.24
5-month	.33	7.76	−2.84	.15	7.73	−8.81	.41	7.79	−.26
7-month	.34	7.29	−2.88	.16	7.52	−8.91	.42	7.20	−.14
9-month	.35	7.01	−2.85	.17	7.34	−8.99	.43	6.89	−.00
12-month	.36	6.70	−2.82	.18	7.15	−9.18	.44	6.51	.15
Average	.34	7.39	−2.84	.16	7.54	−8.89	.42	7.33	−.14
Platinum:									
4-month	.59	9.47	.42	1.04	12.54	1.64	.40	7.84	−.41
7-month	.59	9.44	.46	1.04	12.49	1.67	.40	7.82	−.37
10-month	.59	9.39	.43	1.05	12.45	1.70	.40	7.76	−.35
Average	.59	9.43	.46	1.04	12.49	1.67	.40	7.80	−.37
	1969–83			1978–83			1969–77		
Silver:									
3-month	.82	10.27	2.63	.88	15.46	.32	.79	7.01	5.14
5-month	.82	10.30	2.62	.89	15.52	.35	.80	7.02	5.21
7-month	.83	10.20	2.75	.89	15.34	.38	.80	6.99	5.29
9-month	.84	10.14	2.82	.90	15.25	.42	.81	6.95	5.48
12-month	.85	10.07	2.98	.90	15.14	.46	.82	6.91	5.64
Average	.83	10.20	2.75	.89	15.34	.39	.81	6.98	5.44
	1964–83			1978–83			1964–77		
VSTK[d]	.79	4.24	5.62	1.36	4.53	11.67	.55	4.25	2.87
T-Bill	.55	.24		.83	.23		.43	.12	
T-Bond	.62	3.34		1.48	4.24		.23	2.81	

[a]Number of observations over the entire sample period for copper and platinum and for silver are 240 and 180, respectively.

[b]*SD* denotes the standard deviation of monthly returns.

[c]*Si* denotes the Sharpe Performance Measure.

[d]*VSTK* denotes the value-weighted NYSE stock index.

$$S_i = (R_i - R_f)/\sigma_i, \tag{5}$$

where σ_i denotes the standard deviation of contract returns. The return for bearing risk is shown in the numerator as the average contract return, R_i, minus the average risk-free rate R_f. Intuitively, the measure reflects the excess return earned for bearing risk per unit of total risk.

Table II demonstrates noticeable patterns between contract maturity and mean and volatility of contract returns. For both the whole period and the two subperiods for all three commodity futures, the volatility of the returns declines monotonically with the contract maturity.[11] The pattern is intuitively plausible, being perfectly consistent with the conjecture of Samuelson (1965) concerning the relative variation of spot and forward prices. The average mean returns, on the other hand, are nearly an increasing function of maturity. Thus, longer maturity futures contracts seem to provide long speculators with better return to volatility tradeoffs. Both patterns justify earlier efforts to fix contract maturity.

Apparent shifts in return distributions occurred for all three commodity futures over the two subperiods. Both the average returns and the standard deviations of returns on platinum futures over the six-year period, 1978–1983, were substantially higher than those for the fourteen-year period, 1964–1977. The significant change for silver, however, occurs only in standard deviations. On the contrary, means rather than standard deviations of returns on copper show a major change. This research does not speculate on the cause(s) of the shifts.

Over the entire sample period, silver futures contracts earned the highest average monthly returns and copper earned the lowest. However, silver futures, in general, were also more volatile than both copper and platinum. In sum, copper futures appeared to have the lowest return to volatility ratio over the period, as indicated by the negative Sharpe performance measures.[12]

To facilitate a comparison between alternative investment opportunities, Table II also reports the average returns, the standard deviations of returns, and Sharpe performance measures for the value-weighted CRSP stock index, one-month Treasury bills and a Treasury bond index over the same periods. Most notably, based on the standard deviations of returns, all three futures contracts were consistently riskier than average stocks and government bonds. The conventional belief that traders of commodity futures bear above-average risk is well supported by the data. The estimated Sharpe performance measures indicate, however, that relative to the stock market, these risks had not been well compensated for by the market. An exception occurred between 1969 and 1977 for silver futures. The average S_i for silver during that period was about 1.9 times the measure of common stocks.

Some of the observations based on the Sharpe performance measures in the above paragraph should be interpreted with care. Again, it is debatable whether the risk-free rate should be subtracted from the raw returns in the computation of the Sharpe performance measure for futures. By adding the returns on risk-free assets to the numerator, it was found, but not reported, that both silver and platinum had outperformed the stock market over the whole period.

Monthly raw returns for each of the thirteen contracts are regressed against the excess returns on a proxy of the market portfolio as specified in regression equation (3). Analyses are performed for both the whole period and the two subperiods. As discussed before, evidence documented in early studies regarding whether commodity futures contracts bear systematic risk is sensitive to the proxy index employed. In particular, the weight attached to the Dow Jones Cash Commodity Index has a great impact on the conclusions. In this study, the weight suggested by Elam and Vaught (1988) is followed.

[11]Interestingly, a similar pattern even existed for silver futures during the period January 1964 to May 1968, while the prices were under governmental control. As expected, the average standard deviation of returns was only 4.91, much less than those during the latter periods.

[12]Among the three metals, copper has the highest weight-to-value ratio as well as the storage cost. It is likely that copper is also the least interesting investment instrument among the three.

Table III
ESTIMATED MARKET MODEL COEFFICIENTS FOR COPPER, PLATINUM, AND SILVER FUTURES:

$$R_{it} = a_i + b_i(R_{mt} + R_{ft}) + \varepsilon_{it}$$

Contract	a_i	$S(a_i)^c$	b_i	$S(b_i)^c$	R^2	D.W.	SSE
			Sample Period: 1964–83				
Copper:							
3-month	.002	.005	.489[a]	.127	.059	1.72	.079
5-month	.003	.005	.407[a]	.121	.045	1.85	.076
7-month	.003	.005	.467[a]	.112	.068	1.76	.070
9-month	.003	.004	.436[a]	.108	.064	1.78	.068
12-month	.003	.004	.414[a]	.104	.063	1.80	.065
Average			.443		.060		
Platinum:							
4-month	.005	.006	.397[a]	.149	.029	2.13	.094
7-month	.005	.006	.380[b]	.149	.027	2.13	.093
10-month	.005	.006	.359[b]	.148	.024	2.11	.093
Average			.379		.027		
			Sample Period: 1969–83				
Silver:							
3-month	.008	.008	.591[a]	.190	.051	1.66	.112
5-month	.008	.008	.580[a]	.191	.049	1.66	.113
7-month	.008	.008	.560[a]	.189	.047	1.65	.112
9-month	.008	.008	.548[a]	.189	.045	1.64	.111
12-month	.008	.008	.531[a]	.187	.043	1.64	.110
Average			.562		.047		
Overall average			.474		.047		

[a]Denotes statistical significance at the 1% level.
[b]Denotes statistical significance at the 5% level.
[c]S denotes the standard error of the estimated coefficient.

The estimated coefficients and the corresponding standard errors are reported in Table III.[13] Three observations on the estimated betas merit elaboration. First, the relations between the estimated betas and maturity, in general, are negative. The pattern especially holds for platinum and silver where betas monotonically decline as maturity

[13]The reported Durbin-Watson statistics suggest that a serially independent disturbance term may not be a plausible assumption for silver regressions. Thus, Cochrane-Orcutt (1949) iterative process is utilized to re-estimate the regression coefficients. The estimates are presented below:

	a_i	$S(a_i)$	b_i	$S(b_i)$	R^2
3-month	.008	.010	.516[a]	.186	.041
5-month	.008	.010	.504[a]	.187	.039
7-month	.008	.010	.482[a]	.185	.037
9-month	.008	.010	.469[b]	.184	.035
12-month	.008	.010	.451[b]	.182	.033

These results are not qualitatively different from those reported in the Table III.

increases. Thus, longer maturity futures contain lower total and systematic risks. Second, the study revealed that the systematic risk estimates, b_i's, are all positive, ranging from .359 to .591. The average b_i's for copper, platinum, and silver are .443, .379, and .562, respectively. Thus, the conventional belief that silver may have a negative beta is not supported by the data. Third, contrary to most of the earlier findings for agricultural commodity futures, all of the thirteen b_i's are significant, at least at the 5% level. Thus, all three metal futures have positive systematic risks; they can be viewed as risky financial assets even when they are held as part of a large portfolio of assets.

Within this framework, the Keynesian theory of normal backwardation predicts that traders of futures contracts should be rewarded with a premium that is commensurate to the level of the risk they are bearing. This implication is examined by looking at the magnitudes of the a_i's and the associated t-values. According to Jensen (1968), a_i represents a performance measure of the contract, since it measures the mean of the excess returns earned by the contracts. Table III shows that none of these coefficients are statistically distinguishable from zero. Therefore, the conclusion holds that none of them either outperformed or underperformed the market. The theory of normal backwardation seems to be well supported in Table III.[14]

The same analyses are performed for the pre- and post-1977 subperiods with results reported in Tables IV and V. The former conclusions, based on the whole period analyses, are found to be sensitive to the sampling periods. During the pre-1977 subperiod, b_i's range from .078 to .280 and none of them is statistically distinguishable from zero. Thus, the hypothesis that the systematic risks of the three metals were zero during the period could not be rejected.[15] The insignificant a_i's also indicate no evidence of any excess returns. The results are very similar to that of Dusak (1973), Baxter, Conine, and Tamarkin (1985), and So (1987) for agricultural commodity futures.

On the other hand, all of the b_i's in Table V are statistically significant at least at the 5% level during the second subperiod, 1978 to 1983.[16] The average betas for copper, platinum, and silver over the period were, respectively, .783, .848, and 1.003. In some regressions, the excess market returns could even explain as high as 23% of the variations of changes in returns on the contracts. The insignificant a_i's indicate that all the systematic risks are well compensated for by the market in the second subperiod. Thus,

[14]Whether the results in Table III should be viewed as supporting or rejecting the Keynesian theory of normal backwardation depend on if one is willing to reinterpret the implications of the theory in the CAPM framework. If one insists that the Keynesian theory predicts that all price risks should be rewarded by the market, the evidence in Table II rejects the theory at least for copper futures. This interpretation was apparently adopted by Elam and Vaught. On the other hand, one may also reinterpret the theory in the sense that it only requires a reward in proportion to the amount of the systematic risk borne. The latter interpretation was adopted by CRS as well as in this study.

[15]Similar findings that testing results for agricultural futures are sensitive to the sampling periods have previously been reported by Bernard and Frecka (1987). They found that, contrary to earlier results of Dusak (1973), significant systematic risks existed for agricultural futures over the period from 1972 to 1982.

[16]Again, correction for first-order autocorrelation is required for silver regressions. Following the procedures outlined in footnote 13, the estimates are presented below:

	a_i	$S(a_i)$	b_i	$S(b_i)$	R^2
3-month	.006	.022	.921[b]	.368	.080
5-month	.006	.022	.910[b]	.369	.070
7-month	.007	.022	.856[b]	.366	.071
9-month	.007	.022	.833[b]	.364	.068
12-month	.007	.022	.806[b]	.362	.065

These results are quite similar to those reported in Table V.

Table IV
ESTIMATED MARKET MODEL COEFFICIENTS FOR COPPER, PLATINUM, AND SILVER FUTURES:
$$R_{it} = a_i + b_i(R_{mt} - R_{ft}) + \varepsilon_{it}$$

Contract	a_i	$S(a_i)^a$	b_i	$S(b_i)^a$	R^2	D.W.	SSE
			Sample Period: 1964–77				
Copper:							
3-month	.004	.006	.275	.167	.016	1.59	.082
5-month	.004	.006	.166	.157	.007	1.75	.078
7-month	.004	.006	.280	.144	.022	1.62	.071
9-month	.004	.005	.247	.138	.019	1.66	.068
12-month	.004	.005	.224	.131	.017	1.70	.065
Average			.238		.016		
Platinum:							
4-month	.004	.006	.107	.159	.003	2.01	.078
7-month	.004	.006	.094	.158	.002	2.02	.078
10-month	.004	.006	.078	.157	.002	1.99	.078
Average			.093		.002		
			Sample Period: 1969–77				
Silver:							
3-month	.009	.008	.249	.176	.019	2.05	.078
5-month	.008	.008	.238	.176	.017	2.04	.078
7-month	.008	.008	.237	.175	.017	2.02	.078
9-month	.008	.007	.232	.174	.017	2.00	.078
12-month	.008	.007	.219	.173	.015	1.99	.077
Average			.235		.017		
Overall Average			.203		.013		

[a] S denotes the standard error of the estimated coefficient.

during this period, price risks of going long on these contracts could not be fully eliminated, even when they were held as part of a large portfolio of assets. Here, however, there is no speculation about the reasons for the shift in the characteristics of the risk and returns of these contracts.

V. CONCLUSIONS

The characteristics of the risk and return in copper, platinum, and silver futures have been examined. Based on the standard deviations of returns, results show that all three futures are riskier than average common stocks. Conventional belief that traders of commodity futures bear above-average risk is well supported by metal futures data. However, Sharpe performance measures indicate that the returns earned for bearing risk per unit of total risk for these contracts are generally less than those of common stocks.

However, when the risks and returns for copper, platinum, and silver are analyzed within the context of the Sharpe (1964) and Lintner (1965) capital asset pricing model, a risk premium, commensurate with the systematic risk of each contract, is identified. Contrary to the findings in several studies for agricultural and livestock commodity

Table V
ESTIMATED MARKET MODEL COEFFICIENTS FOR COPPER, PLATINUM, AND SILVER FUTURES: 1978–83

$$R_{it} = a_i + b_i(R_{mt} - R_{ft}) + \varepsilon_{it}$$

Contract	a_i	$S(a_i)^c$	b_i	$S(b_i)^c$	R^2	D.W.	SSE
Copper:							
3-month	−.001	.008	.845[a]	.182	.236	2.07	.070
5-month	−.001	.008	.807[a]	.178	.227	2.08	.068
7-month	−.001	.008	.778[a]	.174	.223	2.07	.067
9-month	−.000	.008	.752[a]	.170	.219	2.03	.065
12-month	−.000	.008	.731[a]	.166	.218	2.01	.064
Average			.783		.225		
Platinum:							
4-month	.008	.014	.874[a]	.311	.101	2.22	.120
7-month	.008	.014	.850[a]	.311	.096	2.21	.120
10-month	.008	.014	.821[a]	.311	.091	2.20	.120
Average			.848		.096		
Silver:							
3-month	.006	.017	1.054[a]	.385	.097	1.51	.148
5-month	.006	.018	1.041[a]	.387	.094	1.51	.149
7-month	.006	.017	.995[a]	.384	.088	1.51	.148
9-month	.006	.017	.974[b]	.382	.085	1.50	.147
12-month	.006	.017	.951[b]	.380	.082	1.50	.146
Average			1.003		.089		
Overall Average			.833		.143		

[a]Denotes statistical significance at the 1% level.
[b]Denotes statistical significance at the 5% level.
[c]S denotes the standard error of the estimated coefficient.

futures, significant systematic risks ranging from .731 to 1.054 are found for these futures over the period, 1978 to 1983.

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