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EFFICIENT ASSET PORTFOLIOS AND THE THEORY OF NORMAL BACKWARDATION

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EFFICIENT ASSET PORTFOLIOS AND THE THEORY OF NORMAL BACKWARDATION*

Keynes (1930), with his theory of normal backwardation, emphasized the financial risk posed by the necessity for carrying inventories of agricultural products, and he suggested futures markets exist to facilitate hedging.[1] In his view, futures prices are unreliable estimates of the cash or spot price prevailing on the date of expiry of the futures contract. He believed it "normal" for the futures price to be a downward biased estimate of the forthcoming spot price. This theory, in effect, argues that speculators sell "insurance" to hedgers and that the market is "normally" inefficient since the futures price is not an unbiased estimate of the subsequent spot price.[2] Keynes argued that hedgers use futures markets to avoid risks and they pay, on the average, a significant premium to the speculator for this insurance. The long speculator realizes the premium by refusing to purchase a contract from the short hedger except at the price below that which the futures price is expected to approach.

Telser (1959, 1960) and Cootner (1960) have both tested their interpretation of the theory of normal backwardation and have obtained conflicting results. Cootner found evidence to support the theory of normal backwardation, while Telser's conclusions were contrary. Several other writers have also tested the validity of the theory of normal backwardation. A succinct summary of their findings is given by Rockwell (1967) when he describes the state of the theory:

> While the theory of normal backwardation may be valid for particular markets under special conditions, it is not adequate as a general explanation of the flow of profits in commodity markets (p. 110).

More recently, Dusak (1973) has examined the existence of a risk premium within the context of the capital asset pricing model (CAPM). Within this approach, she argues that the Keynesian notion of a risk premium takes on a new interpretation. Namely, the risk premium required on a futures contract should depend on the extent to which the variations in prices are systematically related to variations in the return on total wealth. If the CAPM applies and if the risk of a futures contract is independent of the risk of changes in the value of all assets taken together (i.e., no systematic risk), then investors will not have to be paid for that risk. The Keynesian insurance interpretation, on the other hand, identifies the risk of a futures asset solely with its own price variability. Dusak uses the CAPM to generalize the Keynesian formulation and tests for both types of risk in the futures market for these commodities; she concludes that wheat, corn, and soybean futures contracts are not risky assets whether they are held independently or as part of a larger portfolio of assets. These results are appealing since, in contrast to Keynes, Cootner, and Telser, they do not rest on a difference in taste or attitude toward risk among hedgers and speculators.

In a separate study, Schiff (1981) also found that, for commodities such as corn and soybeans, futures prices do not include a risk premium. He supports the Dusak results. However, for cotton, he finds that hedgers do pay a risk premium. He distinguishes between commodities such as corn, which are affected mostly by supply shocks due to weather, and those such as cotton which are more closely related to general economic conditions. He suggests that, for those commodities in which variance in returns is due largely to supply shocks caused by weather variability, a risk premium is not expected to exist. In contrast, for those commodities in which return variances are principally related to demand conditions and thus general economic activity, a risk premium is expected.

The principal problems with Dusak's investigation is that it is based on a misspecified model, and it is restricted to a small set of commodities where systematic risk is most likely to be absent. The purpose of this paper is to correct these two principal deficiencies of the Dusak model. Our analysis focuses on the original and the newer (Dusak) version of the Keynesian theory of normal backwardation and the implications for market efficiency. In Dusak's analysis, it was implicitly assumed that speculators are net long throughout the life of a futures contract and that the well-diversified portfolio of speculators contain only common stocks. In relaxing both of these highly questionable assumptions, we show that, contrary to Dusak's results, holding futures contracts is a risky business and that the "generalized" Keynes' theory of normal backwardation has some merit. Our results are consistent with Rockwell's conviction that the Keynesian theory is valid under special conditions. Moreover, we test the generalized Keynes' theory using the same commodities (wheat, corn, and soybeans) investigated by Dusak and add a subset of commodities more closely related to the general level of economic activity (cotton and live cattle).

The Capital Asset Pricing Model

Using the familiar mean-variance criterion, a general equilibrium model of the pricing of capital assets under uncertainty has been developed by Sharpe (1964) and Lintner (1965a, 1965b). Their model assumes that the market's participants are risk-averse, expected utility-maximizing investors; and it develops a measure of the risk of an asset and the consequent equilibrium relationship between the asset's risk and its one-period expected return.

The major result of the CAPM is often summarized as:

$$E(\tilde{R}_j) - R = \beta_j [E(\tilde{R}_e) - R] \tag{1}$$

where E is the expectation operation; tildes represent random variables; R_j is the return on asset j; $\tilde{R}_e$ is the return on the market portfolio; R is the return on a riskless asset; and $\beta_j = \text{cov}(\tilde{R}_j, \tilde{R}_e)/\text{var}(\tilde{R}_e)$. The systematic (nondiversifiable) risk of asset j, σ_j^s, is equal to $\beta_j\ \sigma(\tilde{R}_e)$. Expressed in units of market risk, $\sigma(\tilde{R}_e)$, the coefficient β_j represents the systematic risk of asset j.

The expression in equation (1) follows that, if investors are generally risk averse and make their portfolio decisions according to the two-parameter (mean and variance) model, then we should, on average, observe a positive trade-off between risk and return along the set of efficient portfolios. The observed asset market returns ($\tilde{R}_j$) should be a reflection of investors' attempts to hold efficient portfolios. An efficient portfolio possesses minimum risk for a given level of expected return. The efficient set of portfolios is shown by bd in figure 1. All portfolios that lie to the right of the envelope curve, bd, are inefficient.

The consumer's attitudes toward risk and return are summarized in the indifference curves labeled $I_1, \ldots, I_4$ in figure 1. The optimal portfolio is represented by point e; and, for the consumer who chooses point e, we should expect to observe the expected return-risk relationship for individual assets as in equation (1).

The CAPM has been slightly reformulated and applied to futures market contracts by Dusak (1973), Black (1976), and Stoll (1979). These efforts represent an extension of the work of Johnson (1960) and Schrock (1971) who

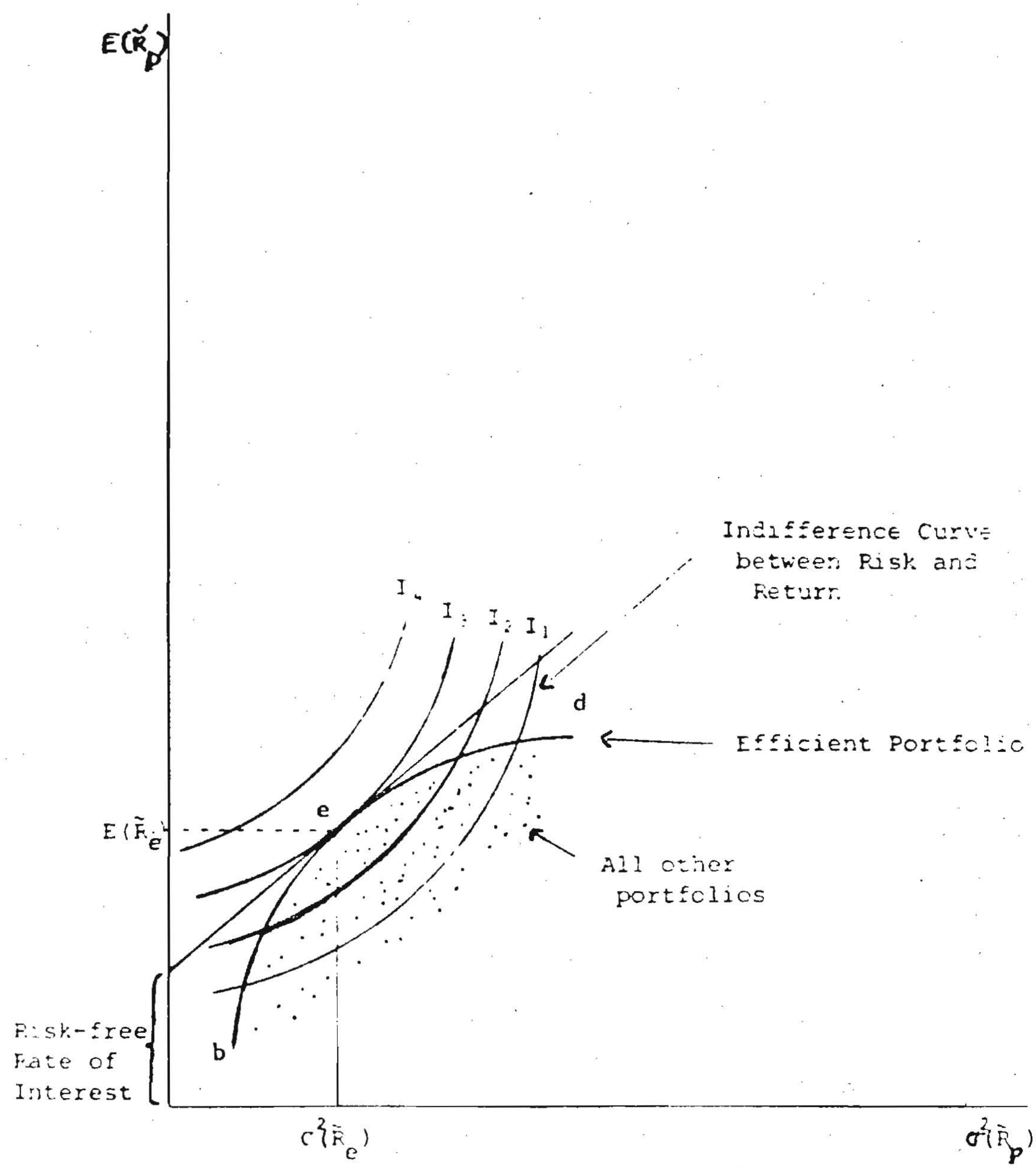

Figure 1. Consumer Equilibrium in the CAPM

had previously adapted the Markowitz mean-variance framework to the futures market.

From equation (1), $E(\tilde{R}_j)$ can be expressed as a return over a given time period. If P_{jo} is the start-of-period price of asset j and P_{j1} is its end-of-period price, one can write equation (1) as:

$$\frac{E(\tilde{P}_{j1} - \tilde{P}_{jo})}{P_{jo}} - R = \left[\frac{\text{cov}\left(\frac{\tilde{P}_{j1} - P_{jo}}{P_{jo}}, \tilde{R}_e\right)}{\text{var}(\tilde{R}_e)}\right] [E(\tilde{R}_e) - R]. \tag{2}$$

Multiplying equation (2) by P_{jo} yields:

$$E(\tilde{P}_{j1} - P_{jo}) - RP_{jo} = \left[\text{cov}\ \frac{(\tilde{P}_{j1} - P_{jo})}{\text{var}(\tilde{R}_e)}\ \tilde{R}_e\right] [E(\tilde{R}_e) - R]. \tag{3}$$

Since the start-of-period value of a futures contract is zero and the end-of-period value of a futures contract is the change in the futures price over the period, ΔP, one can set P_{jo} equal to zero, substitute ΔP_j for P_{j1}, and rewrite equation (3) as:

$$E(\Delta\tilde{P}_j) = \left[\text{cov}\ \frac{(\Delta\tilde{P}_j, \tilde{R}_e)}{\text{var}(\tilde{R}_e)}\right] [E(\tilde{R}_e) - R] \tag{4}$$

or

$$E(\Delta\tilde{P}_j) = \beta_j\ [E(\tilde{R}_e) - R]. \tag{5}$$

Equation (5) expresses a positive linear relationship between the risk of a futures contract and its expected price change (expected return). It is important to note that, in this model, risk is measured from a portfolio point of view, i.e., the risk of a futures contract is measured by its contribution to the risk of the investor's portfolio. As formulated in equation (5), the nondiversifiable portion of the futures market asset j's return can be presumed to be captured by its estimated relationship with returns on the market portfolio.

The Dusak Results

The empirical counterpart of equation (5) is:

$$\tilde{R}_t = \alpha_j + \beta_j \tilde{x}_t + \tilde{\varepsilon}_t \qquad t = 1, 2, 3, \ldots, T \tag{6}$$

where $\tilde{R}_t$ is the one-period return on an individual asset j, $\tilde{x}_t$ is the one-period return on the efficient portfolio, α_j is the normalized unsystematic risk of asset j, and β_j is the normalized systematic risk of asset j. It is assumed that $E(\tilde{\varepsilon}_j) = 0$ for all t; $var(\tilde{\varepsilon}_t) = \sigma^2_\varepsilon$ for all t; $cov(\tilde{\varepsilon}_t, \tilde{\varepsilon}_v) = 0$ for all $t \neq v$; $plim(\Sigma^T_{t=1}\tilde{x}_t\tilde{\varepsilon}_t/T) = 0$; and the number of observations is equal to T.

The relationship in equation (6) is often referred to as the market model. Its parameters have been estimated by Dusak for returns in the wheat, corn, and soybean futures market. In a portfolio framework, Dusak argues that the risk premium of a futures contract should depend only on β (the systematic risk of the asset) in equation (6). This portfolio measure of risk is viewed as being more important than the measure of nonmarket risk [α in equation (6)] because the level of nonmarket risk can be diversified away.

For the independent variable in equation (6), Dusak selects the Standard and Poor (S&P) Index of 500 Common Stocks as a proxy for the return on the efficient portfolio. Semimonthly returns on the futures contracts are employed as the dependent variable. Her data were collected for a 15-year period from 1952 to 1967, and her regression results are presented in table 1. The principal conclusion of the Dusak paper is that futures contracts are not risky assets whether they are held independently or as part of a larger portfolio of assets.

There are two major problems associated with Dusak's analysis. The first is that she implicitly assumes that speculators are net long throughout the life of the futures contract. Empirical evidence indicates this is erroneous. The second is that she uses the return on the value-weighted S&P Index of 500 Common Stocks as a proxy variable for the return on the efficient market portfolio. An alternative proxy (one which gives equal weight to a stock and a commodity index) has more intuitive appeal and is more representative of an efficient portfolio. Bodie and Rosansky (1980) have shown that a market portfolio comprised of common stocks augmented by commodity futures could result in a one-third reduction in variance with no concomitant decline in mean return.

A Respecified Futures Market

As mentioned above, Dusak failed to account for changing speculative positions in the futures market and failed to include commodities in the wealth (portfolio) index. These two issues will be discussed in this section, and an alternative specification of the capital market line in equation (6) will be proposed.

Table 1. Regression Parameters for Wheat, Corn, and Soybeans

Commodity	$\hat{\alpha}'_i$	$SE(\hat{\alpha}'_i)$	$\hat{\beta}_i$	$SE(\hat{\beta}_i)$	R^2	Autocorrelation coefficients of residuals
Wheat:						
July (302)[a]	-.020	.001	.048	.051	.003	.148
March (302)	.000	.001	.098	.049	.013	.080
May (302)	-.000	.001	.028	.051	.001	.163
September (319)	-.002	.001	.068	.051	.006	.149
December (319)	-.000	.001	.059	.048	.005	.163
Corn:						
July (301)	-.001	.001	.038	.046	.002	-.041
March (301)	-.003	.001	-.009	.050	.000	.015
May (301)	-.002	.001	-.027	.048	.001	.032
September (320)	-.002	.001	.032	.048	.001	.100
December (320)	-.001	.001	.007	.047	.000	.017
Soybeans (287 all contracts):						
January	.002	.001	.019	.058	.000	.015
March	.003	.002	.100	.065	.008	.018
May	.003	.002	.119	.068	.011	.071
July	.002	.002	.080	.076	.004	.083
September	.001	.001	.077	.065	.005	.060
November	.002	.001	.043	.058	.002	.023

[a]Figures in parentheses indicate number of observations.

Source: Dusak (1973, p. 1403).

The Market Index

For the market index in equation (6), Dusak selected the S&P Index of 500 Common Stocks. Taken alone, the S&P Index does not account for the price instability of the nation's stock of agricultural and nonagricultural commodities. This results in biased estimates of the degree of systematic risk one should expect for futures contracts if the CAPM is properly interpreted.

The relative importance of commodity assets is attested by the fact that, in 1977, 42.9 million contracts were traded on U. S. commodity futures exchanges. The value of commodities represented by the contracts traded was estimated at $1.23 trillion. The market value of stocks listed on all registered exchanges in 1977 was less than this and approximately equal to $950 billion. Total farm assets in the United States in 1977 had a market value of approximately $655 billion. In any event, commodities have a more important place in the economy than recognized by Dusak.

A more important consideration is the fact that Dusak assumes the CAPM represents a reasonable abstraction from reality and serves as a measure of expected returns in the futures market under normal conditions. However, she fails to appreciate the assumption implicit in the CAPM that the investor holds the "efficient portfolio" [equation (6)]. Bodie and Rosansky have shown that common stock returns and commodity futures returns are negatively correlated, and this provides evidence for the inclusion of commodity assets in any efficient portfolio. Commodity assets are not explicitly included in Dusak's portfolio index.[3]

The above arguments suggest that a more appropriate "efficient portfolio" return variable in equation (6) would be an index composed of the S&P Index of

500 Common Stocks and the Dow Jones and Company (DJ&C) commodity futures index. Since this variable is a theoretical construct and is unobservable, alternative indexes could be proposed. In our analysis, each of the two components will be equally weighted.

Changing Speculative Positions

In the security market literature, it is no longer traditionally assumed that the covariance between the return of a stock and the market rate of return (the β value) is stable over time. The instability of the parameter may arise from changing technology in an industry, variable management decisions, or accounting practices. Stochastic β values have been empirically verified by Sunder (1973), Campanella (1972), and Kon and Jen (1978).

There has been virtually no discussion in the literature on the nature of the systematic risk of a futures contract except for Sharpe's (1978, p. 419) suggestion that the market (systematic) risk of a futures position might change during the season as positions of speculators and hedgers change. On the other hand, the specific level or nonmarket risk of a futures contract has received a disproportionate amount of attention in the literature. Its existence was the subject of the famous Cootner-Telser debate.[4] Cootner provided theoretical and empirical evidence to support the notion that the nonmarket rate of return (α_j) is a stochastic variable that is a function of net hedging pressure. This generalized the Keynesian theory of normal backwardation to allow for variable trader's positions.

There is no a priori reason to adopt Dusak's assumption that the level of nonmarket return [the α parameter in equation (6)] or the level of systematic risk [the β parameter in equation (6)] for a futures contract is stationary over time. The Sharpe (1964) and Cootner (1960) hypotheses will be entertained in the estimation of equation (6) in this paper. The parameters in equation (6) will be assumed to be stochastic and a function of net speculative positions. More specifically, α and β are stochastic and will be specified as a function of the net market position of large speculators represented by Z_t. For a single asset, the relationship between the stochastic parameters ($\tilde{\alpha}_j$ and $\tilde{\beta}_j$) and the exogenous influence Z_t is of the form:[5]

$$\begin{bmatrix} \tilde{\alpha}_j \\ \tilde{\beta}_j \end{bmatrix} = \begin{bmatrix} \alpha_j \\ \beta_j \end{bmatrix} + \begin{bmatrix} \delta_j \\ \gamma_j \end{bmatrix} \tilde{Z}_t + \begin{bmatrix} \tilde{e}_t \\ \tilde{v}_t \end{bmatrix} \tag{7}$$

where α, β, δ, and γ are nonstochastic and where e_t and v_t are error terms. Let $E(\tilde{e}_t, \tilde{\varepsilon}_t) = E(\tilde{v}_t, \tilde{\varepsilon}_t) = 0$ and let $var(e_t) = \sigma_e^2$, $var(v_t) = \sigma_v^2$ and $cov(e_t, v_t) = \sigma_{ev}$.

Combining equations (6) and (7), we may write

$$\tilde{R}_t = \alpha_j + \delta_j \tilde{Z}_t + \beta_j \tilde{x}_t + \gamma_j \tilde{x}_t \tilde{Z}_t + \tilde{u}_t \tag{8}$$

where

$$\tilde{u}_t = \tilde{\varepsilon}_t + \tilde{x}_t \tilde{v}_t + \tilde{e}_t \tag{9}$$

and where

$$var(\tilde{u}_t) = \sigma_\varepsilon^2 + x_t^2 \sigma_v^2 + \sigma_e^2 + 2\tilde{x}_t \sigma_{ev}. \tag{10}$$

If σ_ε^2, σ_v^2, σ_e^2, and σ_{ev} are known, the best linear unbiased estimator of σ_i, δ_i, β_i, and γ_i is provided by generalized least squares (GLS). Unfortunately, these variances and the covariance are unknown and thus a two-stage Aitken estimator is required, with the first stage capturing estimates of σ_ε^2, σ_v^2, σ_e^2 and σ_{ev} and the second-stage estimates of σ_i, δ_i, β_i, and γ_i conditioned upon the first-stage estimates.

In what follows, we employ an approach developed by Mundlak and Rausser (1979). The components of var $(\tilde{u}_t)$ are estimated by applying ordinary least squares (OLS) to equation (8) from which we obtain the estimated residuals. These residuals, $\hat{e}^2 = \dot{\varepsilon}$, are then employed as dependent variables in the regression,

$$\dot{\varepsilon} = \dot{M}\,\dot{x}\,\sigma^2 + W \tag{14}$$

where $\dot{M}$ is the matrix $M = [I - x^*(x^{*\prime}\, x^*)^{-1}\, x^{*\prime}]$ with each element replaced by its square and $\dot{x}$ equals matrix x with each element replaced by its square. The resulting estimates $\hat{\sigma}^2$ contain all variance elements of var $(\tilde{u}_t)$ appearing in equation (10). These estimates are then entered into a GLS framework or the second Aitken stage to obtain asymptotically efficient estimates of α_j, δ_j, β_j, and γ_j.

Empirical Results

Equation (8) was estimated for returns in the soybean, corn, wheat, cotton, and cattle futures markets. For the first three commodities (those examined by Dusak), the results for OLS and GLS are reported in tables 2 and 3, respectively. The dependent variables $(\tilde{R}_t)$ used in the regressions are the first differences of the natural logarithms of weekly average futures prices collected from 1966 through 1976. The independent, $\tilde{Z}_t$, variables were obtained from the Commodity Futures Trading Commission reports. They represent the percentage of reporting speculators that were net long, and thus $\tilde{Z}_t$ lies in the interval between zero and one.[6] Finally, the $\tilde{x}_t$ variables represent first differences of the natural logarithms of the market index (the S&P and DJ&C indices weighted equally) minus the 90-day Treasury Bill rate converted to a weekly interest rate.

The estimated risk coefficients (β) in table 2 are generally significantly different from zero at the .05 percent level of confidence but these t ratios are overstated. The "correct" t ratios in table 3 indicate the GLS estimates of β have relatively large associated standard errors. Nevertheless, the magnitude of th: estimated risk coefficients is an important finding. It is interesting to compare these with Dusak's results in table 1. The contrast is striking. Not one of her estimates of the level of systematic risk (β) is much different from zero and almost all of the t ratios are less than one.

Note that the positive β_i values in tables 2 and 3 suggest that a significant portion of the risk associated with holding a wheat, corn, or soybean futures contract cannot be diversified away. The expected return from holding these assets should, therefore, be larger than the riskless rate of interest. Note also that the degree of systematic risk is not constant across contracts for any of the commodities reported in tables 2 and 3. In the case of soybeans, the highest estimate of systematic risk measure is .936 for the July contract and the lowest is .35 for the September contract (table 3).

The low t ratios associated with the γ_i estimates in tables 2 and 3 suggest that the degree of systematic risk is no larger during periods when

Table 2. Ordinary Least-Squares Regression Parameters for Wheat, Corn, and Soybeans

Commodity	$\hat{\alpha}_i$	$t_{\alpha i}$	$\hat{\beta}_i$	$t_{\beta i}$	$\hat{\delta}_i$	$t_{\delta i}$	$\hat{\gamma}_i$	$t_{\gamma i}$	R^2	D.W.
Wheat:										
March (539)[a]	-.024	-6.87	.721	2.85	.041	7.14	.345	0.80	.22	1.56
May (529)	-.027	-7.99	.804	3.23	.047	8.17	.211	0.49	.24	1.53
July (534)	-.023	-6.51	.891	3.45	.040	6.81	-.120	-0.26	.19	1.72
September (540)	-.022	-6.32	.670	2.60	.039	6.67	.630	1.42	.22	1.55
December (531	-.022	-6.38	.654	2.59	.039	6.69	.579	1.34	.23	1.54
Corn:										
March (542)	-.015	-4.59	.606	1.86	.026	4.93	.247	0.49	.15	1.42
May (538)	-.015	-4.51	.636	1.92	.025	4.80	.172	0.34	.14	1.42
July (544)	-.012	-3.48	.459	1.39	.020	3.84	.334	0.68	.12	1.52
September (542)	-.014	-3.97	.660	1.88	.023	4.16	.175	0.32	.13	1.48
December (532)	-.017	-4.82	.575	1.70	.028	5.23	.365	0.71	.16	1.39
Soybeans:										
January (544)	-.009	-2.71	.724	2.24	.020	3.18	.213	0.36	.10	1.67
March (542)	-.010	-3.32	.771	2.79	.024	4.18	-.041	-0.08	.11	1.41
May (538)	-.011	-2.89	.640	1.91	.023	3.34	.170	0.27	.08	1.54
July (544)	-.001	-3.04	1.044	3.18	.026	3.80	-.497	-0.81	.09	1.47
August (536)	-.011	-3.04	.733	2.35	.024	3.71	.246	0.42	.11	1.46
September (539)	-.010	-2.99	.544	1.76	.022	3.42	.494	0.85	.10	1.48
November (540)	-.010	-3.21	.847	2.97	.021	3.72	-.028	-0.05	.12	1.48

[a]Figures in parentheses indicate number of observations.

Source: Estimated.

Table 3. Generalized Least-Squares Regression Parameters for Wheat, Corn, and Soybeans

Commodity	$\hat{\alpha}_i$	$t_{\alpha i}$	$\hat{\beta}_i$	$t_{\beta i}$	$\hat{\delta}_i$	$t_{\delta i}$	$\hat{\gamma}_i$	$t_{\gamma i}$	R^2	D.W.
Wheat:										
March (539)[a]	-.017	-5.00	.771	1.85	.030	5.32	.239	0.34	.11	1.65
May (529)	-.022	-6.97	.871	2.22	.038	7.12	.070	0.10	.15	1.52
July (534)	-.022	-7.12	.859	2.19	.038	7.21	.087	0.13	.15	1.52
September (540)	-.013	-4.17	.734	1.78	.024	4.50	.547	0.78	.11	1.59
December (531)	-.015	-4.53	.697	1.71	.027	4.79	.483	0.70	.11	1.63
Corn:										
March (542)	-.012	-4.22	.488	1.03	.020	4.40	.354	0.49	.08	1.51
May (538)	-.014	-4.69	.574	1.23	.021	4.61	.169	0.23	.08	1.53
July (544)	-.009	-3.37	.314	0.70	.016	3.55	.464	0.68	.07	1.59
September (542)	-.011	-3.51	.459	0.91	.018	3.76	.349	0.46	.07	1.60
December (532)	-.015	-4.82	.516	1.06	.025	5.15	.354	0.48	.10	1.46
Soybeans:										
January (544)	-.005	-1.69	.675	1.55	.010	1.97	.228	0.28	.05	1.76
March (542)	-.006	-2.34	.736	1.89	.013	2.75	-.072	-0.09	.05	1.52
May (538)	-.004	-1.43	.532	1.16	.009	1.51	.218	0.25	.03	1.54
July (544)	-.005	-1.73	.936	2.09	.013	2.33	-.458	-0.55	.04	1.46
August (536)	-.004	-1.46	.622	1.39	.011	2.06	.205	0.24	.04	1.56
September (539)	-.004	-1.29	.350	0.78	.009	1.72	.634	0.76	.03	1.60
November (540)	-.005	-1.83	.749	1.88	.009	2.01	.022	0.30	.05	1.54

[a]Figures in parentheses indicate number of observations.

Source: Estimated.

speculators are net short than it is during the periods when they are net long. These results must be interpreted with some caution in light of the fact that X_t and $X_t \cdot Z_t$ in equation (8) are not orthogonal.[7]

For the nonmarket rate of returns measure (α_j) and its systematic change associated with net speculator positions, the results are extremely interesting. The estimated α_i and δ_i values are almost all significantly different from zero and the δ_i values tend to be roughly twice as large as the α_i values, and they are of opposite sign. This result provides an interesting interpretation of the Cootner hypothesis. Recall that the value of $\tilde{\alpha}_j = \alpha_i + \delta_i\tilde{Z}_t$ represents the expected value of the nonmarket component of a futures contract's excess return. When $\tilde{Z}_t$ is equal to .5, the net position of speculators is neither long nor short; and the results in tables 2 and 3 suggest that the nonmarket returns are near zero. When $\tilde{Z}_t > .5$, speculators are net long and the rate of return is greater than the amount predicted by the market model. Similarly, when $\tilde{Z}_t < .5$, speculators are net short, and there are negative returns in excess of the market return. Negative returns are desirable to a short speculator. The value of $\hat{\alpha}_i + \hat{\delta}_i Z_t$ represents the expected value of the nonmarket component of a futures contract's excess return. Our results indicate that it is significantly different from zero and that it is a function of net speculative positions. This provides support for the Cootner hypothesis of a significant degree of normal backwardation in the futures market given an appropriate interpretation of the net position of speculators.

For commodities more closely related to the general level of economic activity (cotton and live cattle), the GLS estimates are reported in table 4. These results for the nonmarket component, $\hat{\alpha}_i + \delta_i\hat{Z}_t$, conform to the

Table 4. Generalized Least Squares Regression Parameters for Cotton and Cattle

Commodity	$\hat{\alpha}_i$	$t_{\alpha i}$	$\hat{\beta}_i$	$t_{\beta i}$	$\hat{\delta}_i$	$t_{\delta i}$	$\hat{\gamma}_i$	$t_{\gamma i}$	R^2	D.W.
Cotton:										
March (387)[a]	-.00802	- 2.406	.0941	.385	.0142	3.184	.954	2.701	.133	1.64
May (386)	-.00763	- 2.225	.0329	.130	.0141	3.068	.966	2.60	.120	1.62
July (388)	-.00783	- 2.307	.357	1.390	.0139	3.084	.456	1.216	.102	1.67
October (385)	-.00951	- 2.758	.285	1.106	.0168	3.707	.636	1.750	.135	1.64
December (387)	-.00741	- 2.28	.0850	.347	.0144	3.319	.848	2.395	.113	1.64
Cattle:										
February (401)	-.0323	- 9.667	.241	.897	.0497	10.63	-.308	- .805	.229	1.31
April (397)	-.0370	-10.046	.293	1.059	.0564	10.71	-.246	- .615	.245	1.31
June (395)	-.0244	- 4.381	.842	1.808	.0388	4.914	-.959	-1.421	.0689	1.40
August (401)	-.0272	- 9.122	.0664	.267	.0428	10.017	-.156	- .421	.203	1.43
October (398)	-.0331	- 9.962	.311	1.117	.0499	10.53	-.272	- .671	.239	1.49
December (399)	-.0393	-12.87	.354	1.233	.0588	13.54	-.300	- .720	.337	1.48

[a]Figures in parentheses indicate number of observations.

Source: Estimated.

results for wheat, corn, and soybeans. That is, for both cotton and live cattle, this component is significant. Moreover, for cotton, when speculators are net long (short), excess returns are achieved.

Disregarding the net position of speculators, the systematic risk estimate, β_i is insignificant. However, for cotton, when this measure is combined with the net position of speculators, i.e., $\hat{\beta}_i + \hat{\gamma}_i Z_t$, systematic risk is significant and positive. In the case of live cattle, regardless of the speculator net position, systematic risk is insignificant but positive within the sample range for $\tilde{Z}_t$. Hence, for cotton, the Dusak hypothesis must be rejected. Cotton futures market returns clearly incorporate a premium for risk.

Conclusion

The major purpose of this paper was to evaluate the portfolio interpretation of futures market investment risk. The generalization of the Keynesian notion of a risk premium, provided by the CAPM was the focus of our analysis. Proceeding along similar lines, an earlier investigation by Dusak concluded that wheat, corn, and soybeans futures contracts are not risky assets. Presumably, this conclusion did not depend upon whether the futures market assets were held independently or as part of a larger portfolio of assets. For most commodity speculators, this conclusion indeed comes as a huge surprise.

The CAPM, as formulated by Dusak, has been restructured in our analysis to correct for two major specification errors. First, speculators can be either net short or net long; and, second, a well-diversified portfolio or speculators contains not only common stocks but, as well, futures market positions. Respecified empirical models for the three commodities examined by

Dusak--wheat, corn, and soybeans--reveal significant and positive systematic risk for a number of futures contracts. In addition, the "nonmarket" rate of return measure proved to be generally significant. For commodities more closely linked to the general level of economic activity (cotton and live cattle), similar results were obtained. The results for cotton are particularly striking. Not only do net long (short) speculators earn excess returns but the degree of systematic risk is conditioned upon whether speculators are net short or net long.

For an efficient portfolio and an application of the CAPM to futures contracts that allows for changing speculative position, our analysis supports the generalized Keynesian theory of "normal" backwardation. Given an appropriate interpretation of the net position of speculators, a generalized version of Cootner's risk premium is also consistent with our results. In any event, commodity speculators who have lost large sums of money will be delighted to learn that, in general, the risk they faced could not have been "diversified away."

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Footnotes

[*] Giannini Foundation Paper No.   (for identification only).

[1] As with a good portion of Keynes' work, his theory of normal backwardation has been given many interpretations. The following discussion of this theory is, therefore, more of a discussion of post-Keynes interpretations of his theory.

[2] Loosely defined, when the futures market price, $p_T(t)$ at time t, of a contract which matures at time, T, is an unbiased estimate of the forthcoming spot price at T discounted by any long-run trends, the efficiency criterion is satisfied. For further clarification, see Samuelson (1965) and Stein (1981).

[3] Commodities held by public firms, whose stocks are included in the S&P Index, are implicitly included in her market index even though she does not state so.

[4] The specific level of risk is the risk of a futures contract that is independent of the "market" (portfolio) returns. Cootner and Telser measured the risk of a futures contract solely by its own price variability. We are interpreting their arguments to also apply to $\alpha_j = R_t - \beta_j x_t - \varepsilon_t$.

[5] For the formal derivations and frameworks for other time-varying parameter formulations, see Mundlak and Rausser (1979).

[6] Excludes spreading positions.

[7] Given the very large sample sizes used, we can be reasonably confident that the estimates of β and γ are robust; but due to the multicollinearity problem, their associated standard errors may be imprecise. It should be noted, however, that, when the interaction term $(x_t Z_t)$ was deleted, the basic results were robust.