5 RISK AND RETURN IN FUTURES MARKETS

Hedgers enter the futures market to reduce or eliminate the risk of a commodity position. Conceivably, the futures market could consist solely of hedgers. For example, farmers may want to sell wheat futures, while processors of wheat may want to buy wheat futures. Both these parties are hedgers and could have futures transactions that exactly offset each other. But usually the transactions of the long and short hedgers are not exactly offsetting. Liquid and active futures markets typically require the participation of speculators. Speculators analyze information concerning futures contracts and their underlying commodities in the hope of identifying, and profiting from, futures contract mispricings.

5.1 ROLE OF SPECULATORS

Speculators are willing to *bear risk* that others—hedgers—wish to avoid. Consequently, society benefits. Speculators also help determine futures prices that more accurately reflect underlying economic conditions. This is sometimes called the *price discovery* function of futures markets. Speculators help "discover" the right price by analyzing underlying economic conditions and trading based upon their analyses. If the futures price is too low, speculators buy futures, and, if the futures price is too high, they sell. In equilibrium, the futures price is a consensus estimate of what speculators think the future price of the underlying commodity ought to be. If speculators are wrong, they lose money. If they are right, they make money. As in any financial market, the profit motive causes prices to be good estimates of true economic values.

Many different types of speculators and speculative strategies are possible. Sometimes a speculator concentrates on a particular commodity and, based upon his analysis, concludes that the price will go up (or down). In this case, a naked long (or naked short) position is appropriate. At other times, a speculator may conclude that a particular futures contract will increase in price relative to another futures contract. In this case, the speculator buys one contract and sells the other, thereby becoming a "spreader." A spreader benefits only from a favorable change in the difference between two futures prices, whereas a naked speculator benefits from a change in a particular futures price.

5.2 IS THE FUTURES PRICE AN UNBIASED ESTIMATE OF THE EXPECTED SPOT PRICE?

The expected spot price, $E_t(\tilde{S}_T)$, is the market's expectation at time t of the spot price when the futures contract expires (time T). At any given time t prior to contract maturity, the expectation is likely to be wrong. Unexpected events after time t cause the actual spot price to be different from what was expected. Over a long period of time and many futures contract cycles, however, expectations should, on average, be realized, that is, $E_t(\tilde{S}_T) = \text{avg } S_T$. In other words, the average spot price at maturity ought to reflect the expectation at some prior time.

In order for speculators to make money, futures prices must trend upward toward the expected spot price when speculators are long futures, and futures prices must trend downward when speculators are short futures. A market in which futures prices trend upward [i.e., where $F_t < E_t(\tilde{S}_T)$] is said to exhibit *normal backwardation*. This situation is illustrated as the upward sloping line in Figure 5.1. A market

FIGURE 5.1 Normal Backwardation

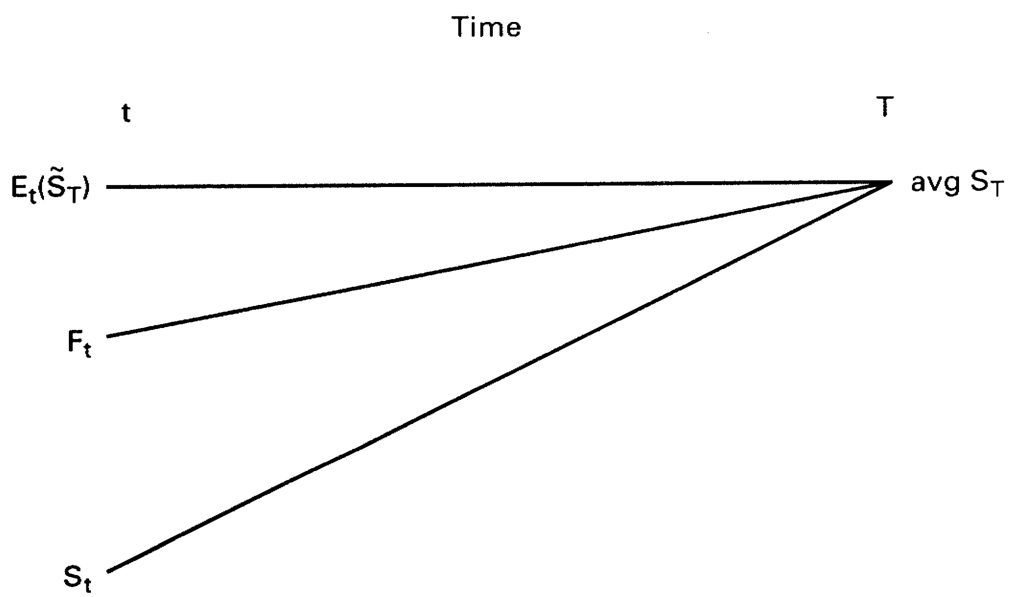
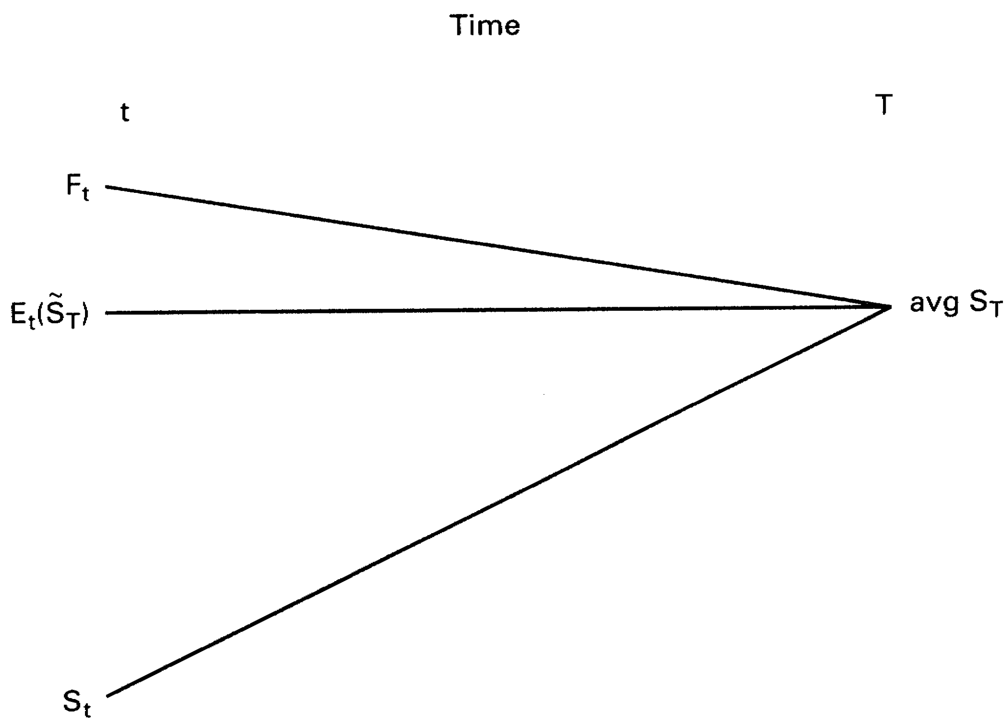


FIGURE 5.2 Contango



in which futures prices trend downward [i.e., where $F_t > E_t(\tilde{S}_T)$] is said to exhibit *contango*. This situation is depicted in Figure 5.2 as the downward sloping line. If there is no trend in the futures price, the futures price is an unbiased estimate of the expected spot price, that is, $F_t = E_t(\tilde{S}_T)$.

Students of futures markets have long discussed whether or not speculators as a group make money. Some, like Keynes (1930), Hicks (1939), and Cootner (1960a, 1960b) argue that speculators make money because they bear risk and must be compensated for their risk-bearing services. They usually argue that speculators tend to be long futures because hedgers tend to be short.[1] Sales by hedgers force the futures price below the expected spot price and lead to the situation of normal backwardation shown in Figure 5.1. Speculators make money on the upward trend in futures prices.

Others, particularly Telser (1958, 1960), argue that speculators as a group are not risk-averse and do not require compensation for risk. This is possible if there are different categories of speculators. Professional speculators have to make money. Otherwise, they would be unable to support themselves. But amateur speculators could lose money to professional speculators, so speculators as a group just break even. Amateur speculators consist of two categories—gamblers and fools.

[1] That is, on balance, there are more short hedgers than long hedgers.

Gamblers enjoy the risks of small futures positions. They know the risks and the fact that there is a house-take, but they enjoy the game. Fools believe they have a successful strategy. They think they know how to make money in futures, but do not. Fools tend to lose money and then withdraw from the market. The supply of fools is replenished by *Barnum's Law*. (There's a sucker born every minute!) Telser thus argues that speculators as a group do not make money even though they bear risk. If Telser's argument is true, hedgers are better off because they are provided insurance at no cost.

Finally, some argue that the amount of risk actually borne by speculators is small, if risk is properly measured. Dusak (1973) takes this position. In modern finance theory, the appropriate measure of risk is the amount of risk that cannot be diversified away. In other words, risk is measured in a portfolio context. Dusak argues that commodity risk can be diversified away so that the systematic risk of a commodity is zero. That means that speculators do not require a risk premium. Competition among speculators for futures contracts will then drive the futures price to a point such that the futures price equals the expected spot price. To the extent that the systematic risk of futures contracts is negative, speculators might be willing to accept losses. For example, suppose futures were a good inflation hedge. In such a situation, speculators would be willing to lose money in futures as a way to reduce the risk in other parts of their portfolio.

5.3 THE CAPITAL ASSET PRICING MODEL FOR FUTURES CONTRACTS

The most familiar form of the Sharpe (1964)–Lintner (1965) capital asset pricing model (CAPM) is the security market line relation,

$$E(\tilde{R}) = r + [E(\tilde{R}_M) - r]\beta, \tag{5.1}$$

where r is the riskless rate of interest, $\tilde{R}_M$ is the rate of return on the market portfolio, and β is the asset's *beta* or *relative systematic risk coefficient.* Equation (5.1) says that the expected rate of return on a risky asset, $E(\tilde{R})$, equals the riskless rate of return, r, plus a market risk premium equal to the market price of risk, $[E(\tilde{R}_M) - r]$, times the asset's relative systematic risk level, β. Assume that the entire asset return is derived from price appreciation (depreciation), that is, $\tilde{R} = (\tilde{V}_T - V_0)/V_0$, where V is the asset price. Then equation (5.1) may be rearranged to derive an expression for the current asset price:

$$V_0 = \frac{E(\tilde{V}_T) - \gamma\left[\frac{\text{Cov}(\tilde{V}_T, \tilde{R}_M)}{\sigma^2(\tilde{R}_M)}\right]}{1 + r}, \tag{5.2}$$

where $\gamma \equiv [E(\tilde{R}_M) - r]$. Equation (5.2) says that the value of an asset today is the difference between expected terminal value of the asset and an appropriate risk adjustment discounted to the present at the riskless rate of interest.

To see how the capital asset pricing model applies to futures contracts, recognize that the terminal value of a long futures position is

$$\tilde{V}_T \equiv \tilde{F}_T - F_0, \tag{5.3}$$

where F_0 is the futures price when the contract is negotiated and $\tilde{F}_T$ is the uncertain futures price when the contract expires.[2] Substituting (5.3) into (5.2) yields

$$V_0 = \frac{E(\tilde{F}_T) - F_0 - \gamma\left[\frac{\text{Cov}(\tilde{F}_T - F_0, \tilde{R}_M)}{\sigma^2(\tilde{R}_M)}\right]}{1+r}. \tag{5.4}$$

However, the value of a futures position when the contract is first entered into is zero (i.e., the futures position involves no initial investment outlay). Setting $V_0 = 0$ in (5.4) and rearranging yields

$$E(\tilde{F}_T) - F_0 = \gamma\left[\frac{\text{Cov}(\tilde{F}_T - F_0, \tilde{R}_M)}{\sigma^2(\tilde{R}_M)}\right]. \tag{5.5}$$

Dividing both sides of (5.5) by the initial futures price F_0,

$$E(\tilde{R}_F) = \gamma\left[\frac{\text{Cov}(\tilde{R}_F, \tilde{R}_M)}{\sigma^2(\tilde{R}_M)}\right], \tag{5.6}$$

where $\tilde{R}_F$ is the futures return, that is, $\tilde{R}_F = (\tilde{F}_T - F_0)/F_0$. Simplifying, equation (5.6) can be written as

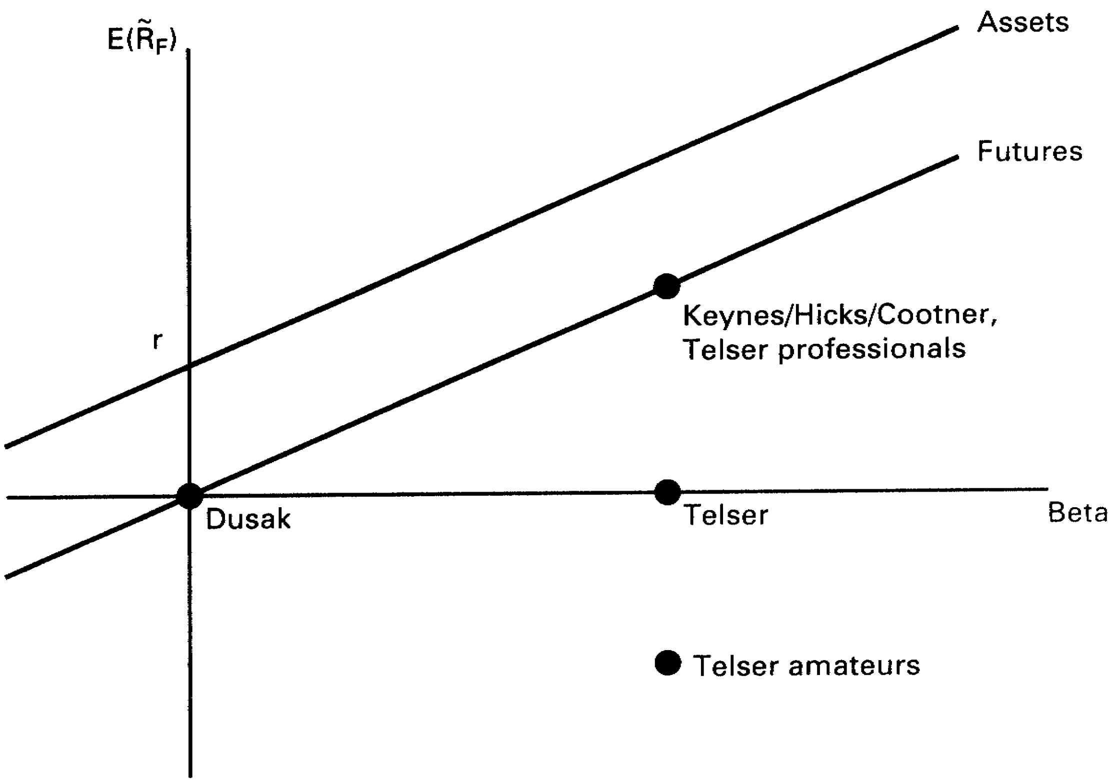
$$E(\tilde{R}_F) = [E(\tilde{R}_M) - r]\beta_F, \tag{5.7}$$

where β_F is the futures contract *beta.*

Figure 5.3 contrasts the expected return/risk relation for assets with the expected return/risk relation for futures contracts. The two lines depicted in Figure 5.3 have the same slope, however the line corresponding to assets has an intercept equal to the riskless rate of interest while the line corresponding to futures contracts goes through the origin. Since asset positions require an investment outlay, an expected rate of return of at least the riskless rate is earned on the asset position. Since futures positions require no investment outlay, the minimum expected return for a futures contract is zero. In equilibrium, the expected rate of return on futures

[2] In (5.3), the daily settlement feature of futures is ignored. The interest earned or paid on daily settlements ought to be a part of the profit or loss on the futures position. Usually the interest amount is very small. In addition, we have shown in Chapter 3 that, if interest rates are known and transaction costs are zero, futures market positions can be adjusted so that expression (5.3) is an appropriate measure of profit on a futures contract.

FIGURE 5.3 The Capital Asset Pricing Model and Alternative Views of the Returns to Speculators



equals only a market risk premium equal to the market price of risk times the futures contract beta.

In the preceding section, we discussed three alternative views of the expected return to holding futures contracts. Under the Keynes/Hicks/Cootner view, speculators earn a positive risk premium. That view is reflected in Figure 5.3 as a position along the futures pricing line with a positive level of systematic risk. The positive return is earned from the upward drift in futures prices when speculators are long. An alternative view is that of Dusak, who argues that futures contracts have no systematic risk. In other words, the beta of a futures contract is zero. In that case, futures contracts are also on the futures contract pricing line but at the point where the line crosses the origin and where beta equals zero. Under the Dusak view, there is no upward drift in futures prices because no compensation for risk is necessary. Under the third view, that of Telser, speculators in the aggregate earn no risk premium, even though risk exists. The Telser position in Figure 5.3 is an average of the position of professionals and amateurs in the figure. Professionals earn a normal risk premium and are on the futures pricing line. However, gamblers and fools earn negative returns as shown in the figure. The average of these two points is the Telser position—positive risk but no return.

The empirical evidence on risk and return in futures markets is ambiguous and makes it difficult to distinguish among these three alternative views. Telser and

Cootner debated vehemently in the 1960's as to the meaning of the data for corn, wheat, and cotton. Cootner maintained that an upward drift in futures prices was observable, while Telser argued it was not.

In a comprehensive investigation using semi-monthly price data for corn, wheat, and soybean futures during the period May 1952 through November 1967, Dusak (1973) concludes that the expected futures returns equal zero. To support her conclusions, she estimates (a) the mean realized futures return and (b) the systematic risk coefficient for each of the futures contract months of the three underlying commodities. The systematic risk coefficients are estimated using the OLS regression,

$$\tilde{R}_{F,t} = \alpha_F + \beta_F(\tilde{R}_{M,t} - r_t) + \tilde{\epsilon}_t, \quad (5.8)$$

where the proxy for the market return, $\tilde{R}_{M,t}$, is the price appreciation on the S&P 500 stock portfolio, and the proxy for the riskless rate, r_t, is the return on a T-bill with fifteen days to maturity. The results are reported in Table 5.1.

In Table 5.1, note first that in only two of the sixteen cases reported is the mean realized return significantly different from zero (i.e., twice its standard error), and in both of those cases the realized return is negative. These results are further corroborated by the estimates of the systematic risk coefficients. In only one of the sixteen cases is the beta of the futures contract significantly different from zero. The lack of covariation of the futures returns with the market return is also reflected through the low R^2 values reported in the table.

All in all, the Dusak results appear to support the position that futures prices are unbiased predictors of expected spot prices, however, the generality of the results is not known. Other investigators have found different results as far as agricultural and metal futures markets are concerned.[3] A broader range of underlying commodities and longer time series of daily or weekly prices are among the experimental improvements necessary to determine which of the competing theories is best supported.

5.4 EQUILIBRIUM OF HEDGERS AND SPECULATORS

The CAPM indicates that speculators could receive a risk premium for holding futures contracts. Obviously, some other group would have to pay a risk premium, since futures are a zero-sum game. Hedgers may be willing to pay a risk premium to eliminate the risk of holding the commodity. The situation is more complicated than that described in Chapter 4 because a hedger would consider not only the

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[3]Bodie and Rosansky (1980), for example, analyze futures prices for the period 1949 and 1976 and conclude that futures contracts on average have a positive return. Unfortunately, the Bodie/Rosansky results are suspect given that they use annual data (and, hence, very few time-series observations) in their statistical analyses.

TABLE 5.1 Summary of regression test results from Dusak (1973).

Contract		Number of Obs.	$\bar{R}_F$	$s(\bar{R}_F)^a$	$\hat{\beta}_F$	$s(\hat{\beta}_F)$	R^2
Wheat:							
	Jul.	302	−.00164	.00126	.048	.051	.003
	Mar.	302	.00060	.00139	.098	.049	.013
	May	302	.00096	.00142	.028	.051	.001
	Sep.	319	−.00194	.00127	.068	.051	.006
	Dec.	319	.00044	.00134	.059	.048	.005
Corn:							
	Jul.	301	−.00158	.00116	.038	.046	.002
	Mar.	301	−.00381	.00138	−.009	.050	.000
	May	301	−.00268	.00120	−.027	.048	.001
	Sep.	320	−.00243	.00128	.032	.048	.001
	Dec.	320	−.00212	.00147	.007	.047	.000
Soybeans:							
	Jan.	287	−.00025	.00146	.019	.058	.000
	Mar.	287	−.00029	.00152	.100	.065	.008
	May	287	.00038	.00148	.119	.068	.011
	Jul.	287	.00006	.00158	.080	.076	.004
	Sep.	287	−.00105	.00157	.077	.065	.005
	Nov.	287	−.00071	.00137	.043	.058	.002

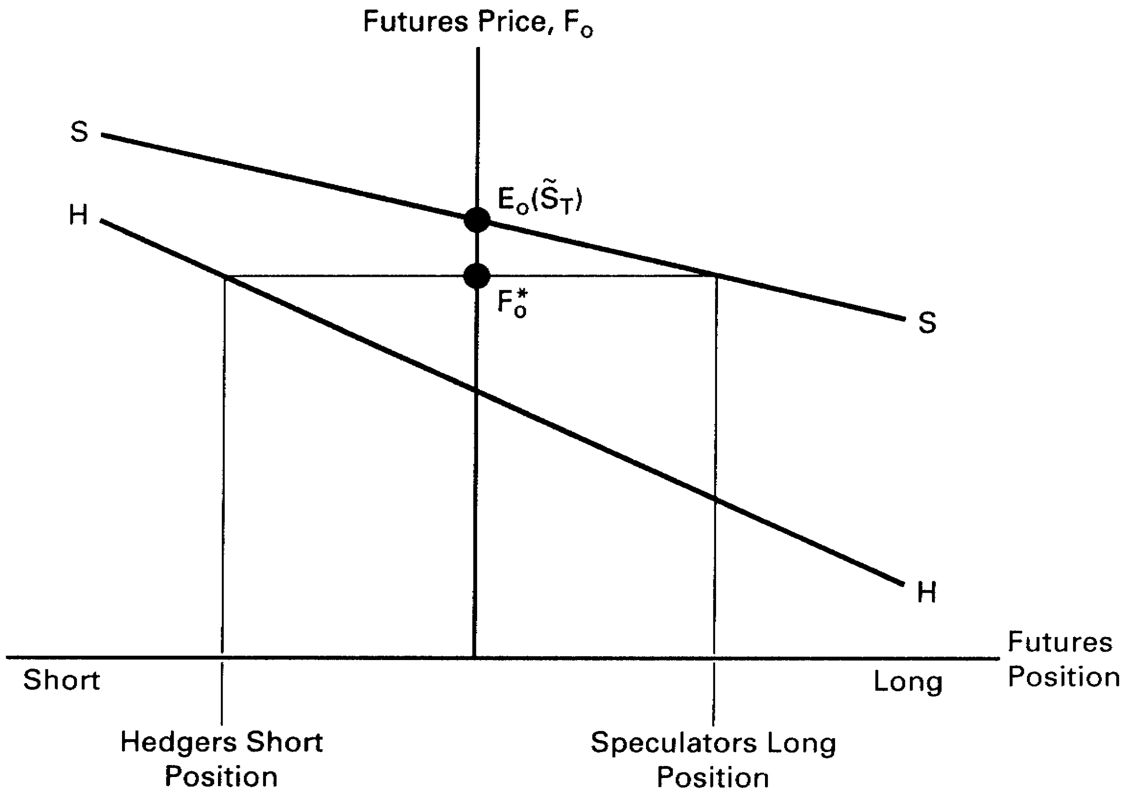
a. $s(\cdot)$ is the estimated standard error of the regression coefficient.

correlation between the futures price and the price of the underlying commodity but also the relation between the futures and the hedger's entire portfolio of all assets.[4]

Figure 5.4 shows how hedgers and speculators interact to determine a futures price in relation to the expected spot price and the current spot price. The figure assumes homogeneous expectations on the part of hedgers and speculators. Hedgers are distinguished from speculators because they have a position in the underlying commodity. The HH schedule in Figure 5.4 depicts the futures market position that hedgers as a group would like to hold for alternative futures prices. Note that the HH schedule crosses the vertical axis below the expected spot price. That means that hedgers would sell futures at prices below the expected spot price because of the attractiveness of risk transfer. The position of the HH schedule depends on the

[4]See Stoll (1979) for a more detailed discussion of this point.

FIGURE 5.4 Equilibrium Futures Price



nature and size of the underlying commitment. The slope of the schedule depends on the amount of price risk of the underlying commodity and the degree of risk aversion of hedgers.

The SS schedule depicts the futures market positions that speculators would accept for alternative futures prices. The SS schedule is downward sloping and intersects the vertical axis at the expected spot price. When the futures price equals the expected spot price, the speculator has no incentive to take a futures position—either long or short. When the futures price falls below the expected spot price, speculators earn a risk premium by taking a long position; and when the futures price is above the expected spot price, speculators earn a risk premium by taking a short position. The downward sloping SS schedule implies that a larger risk premium is required to induce speculators to take a larger position.[5]

In Figure 5.4, the equilibrium futures price, F_0^*, is determined such that the short position taken by hedgers equals the long position taken by speculators. Speculators expect to receive a risk premium of $E_0(\tilde{S}_T) - F_0^*$, and hedgers expect to pay that risk premium. Hedgers hold real assets (like wheat or common stocks) and sell futures to avoid risk. Speculators accept the risk; and, in return, earn a risk pre-

[5] Such an increase in risk premium as a function of position size is not modeled in the standard one-period capital asset pricing model.

mium. Figure 5.4 is consistent with the Keynes/Hicks/Cootner view and a capital asset pricing model in which the underlying commodity has systematic risk.

Under the Telser and Dusak views of speculators, the SS schedule would be perfectly horizontal and would cross the vertical axis at $E_0(\tilde{S}_T)$. In such a case, hedgers would receive insurance at no cost, and speculators would, as a group, not earn a risk premium.

It is possible that the risk premium is time-varying, particularly in agricultural commodities, which have a seasonal harvest cycle. In the case of a commodity like wheat, for example, hedgers might be long wheat and short wheat futures in the fall after the harvest has come in, and they might be short wheat and long wheat futures in the spring when handlers of wheat make commitments to deliver wheat that they do not yet have in hand. In terms of Figure 5.4, such a seasonal pattern would imply an HH schedule below the SS schedule in the fall and an HH schedule above the SS schedule in the spring. In the fall, speculators are long futures and $F_0 < E_0(\tilde{S}_T)$; and in the spring, speculators are short futures and $F_0 > E_0(\tilde{S}_T)$. Futures prices would display normal backwardation in the fall when speculators indirectly bear the risk of the long positions in the commodity that has been harvested. In the spring, futures prices would display contango when speculators indirectly bear the risk of the short positions in the underlying commodity assumed by hedgers.

5.5 SUMMARY

In this chapter, the role of speculators and the returns speculators can expect in an efficient market are discussed. Some researchers argue that futures prices are unbiased estimates of subsequent spot prices, which means that futures prices do not trend up or down over time. In that case, speculators as a group do not make profits. The absence of speculative profits is possible if amateur speculators lose to professional speculators so that speculators as a group do not make profits. The absence of profits is also possible if the risk of holding futures contracts is fully diversifiable. If the risk can be diversified away, no risk premium is required to induce speculators to hold futures contracts.

On the other hand, some researchers argue that futures prices trend up (normal backwardation) or trend down (contango). If futures prices have a trend, speculators as a group make profits commensurate with the level of risk that they assume from hedgers.

This chapter also derives the expected return to speculators under the Sharpe–Lintner capital asset pricing model. Since futures contracts require no investment, the expected return of a futures contract equals only the futures contract's market risk premium (no riskless return is earned). The last section of the chapter contains a model in which hedgers and speculators interact and determine an equilibrium futures price.