Visualizing Risk Premiums in Commodity Futures Markets

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John Maynard Keynes
The Treatise on Money

But the existence of a contango does not mean that a producer can hedge himself without paying the usual insurance against price changes. ... In other words, the quoted forward price, though above the present spot price, must fall below the anticipated future spot price by at least the amount of the normal backwardation.

1930

Holbrook Working
The American Economic Review, 43(3)

The role of risk-avoidance in most commercial hedging has been greatly overemphasized in economic discussions.

Most hedging is done largely, and may be done wholly, because information on which the merchant or processor acts leads logically to hedging. He buys the spot commodity because the spot price is low relative to the futures price and he has reason to expect the spot premium to advance; therefore he buys spot and sells the future.

1953

Lester G. Telser
The Journal of Political Economy, 66(3)

Although hedgers may be willing to pay speculators to bear the risks of price changes, they need not do so if speculators are eager to speculate.

Firms that hedge can reduce their price risks at little at no cost to themselves. I accepted the hypothesis that the futures price equals the expected spot price.

1958

Paul H. Cootner
The Journal of Political Economy, 68(4)

If hedging is always net short, then speculators as a group must be net long, and they can make money only if they sell at prices higher than those at which they bought. ... If commitments to deliver wheat are large, the hedging interest may be long and speculators short prior to the harvest. Under these conditions, prices must fall if speculators are to make money.

1960

Katherine Dusak
The Journal of Political Economy, 81(6)

...Under [capital asset pricing model] approach the risk premium required on a futures contract should depend not on the variability of prices but on the extent to which the variations in prices are systematically related to variations in the return on total wealth. The systematic risk was estimated for a sample of wheat, corn, and soybean futures contracts over the period 1952 to 1967 and found to be close to zero in all three cases.

1974

1. Introduction to commodity futures

A futures contract is an agreement to buy or sell a specific amount of a commodity or financial instrument at a particular price on a stipulated future date. Contract obligations can be offset before the settlement date.

Economic benefits of futures markets include price discovery and risk transfer. Price discovery means that futures prices contain information about future cash prices at the settlement date. Risk transfer means producers or processors of a commodity can greatly reduce price risk by entering a futures contract.

2. What are risk premiums?

Does reducing price risk by hedging impose costs on hedgers? If futures price is lower than the expected spot price at the settlement date, than sellers of the commodity who take net short positions incur a cost known as the risk premium.

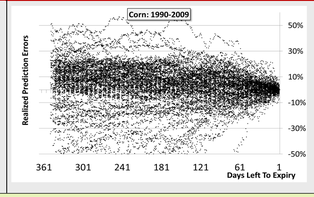
$F_{T-t} = E_{T-t}(P_T)$ no risk premium

$F_{T-t} > E_{T-t}(P_T)$ positive marginal risk premium

$F_{T-t} < E_{T-t}(P_T)$ negative marginal risk premium

Foundations of the literature on risk premiums are presented in the timeline above.

3. Can we graph risk premiums?



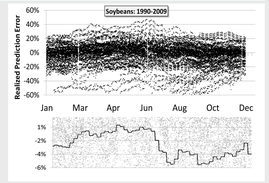
We develop an elegant way to gain a first-pass intuition concerning performance of a futures market for a commodity. Define the **realized prediction error as**

$$\varepsilon_{t,T} = \frac{F_{T-t} - P_T}{F_{t-t}} \times 100$$

If there is no risk premium, then the expected value of ε_{T-t}, conditional on information known at *T-t*, is zero. A scattergram is drawn with calendar days to maturity *T-t* on the x-axis, and percentages on the y-axis. Each ordered pair ($T\text{-}t$, ε_{T-t}) is the locus of one dot in the graph. Under an assumption of no risk premium, as number of contracts charted grows the mean of realized prediction errors with same days-to-maturity should go to zero.

4. Uncovering seasonality effects

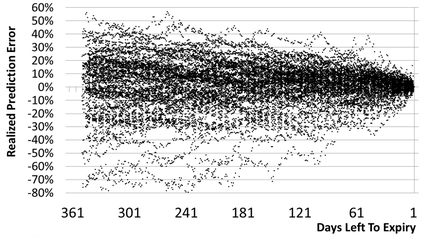
If instead of time-to-maturity we chose the x-axis to be the day of the year, we may be able to uncover any potential seasonal patterns in risk premiums. Effects are best seen when looking at means instead of the entire scattergram.



5. Conclusions

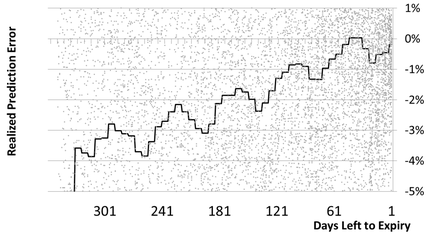
Utilizing realized prediction errors we can graphically show the forecasting performance of futures prices over an extended time period. Using this method we can easily identify time-to-maturity and seasonality components of risk premiums. Figures developed reveal nonlinear behavior of forecasting bias in the time-to-maturity dimension, and the importance of information revealed at the end of June for seasonal pattern of bias. In further research we will develop statistical tests for futures prices unbiasedness based on correlated realized prediction errors.."

soft red wheat



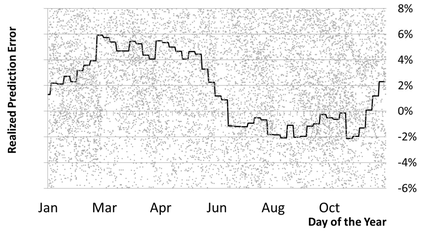
The above figure shows strong negative skewness of realized prediction errors at long horizons. This phenomenon is well known from the theory of storage: In times when harvest is abundant, storage can mitigate the downward pressure of prices. In times when harvest is small, past inventories can supplement supply only so much. Means of realized prediction errors are close to zero for the entire time-to-maturity horizon.

soybeans



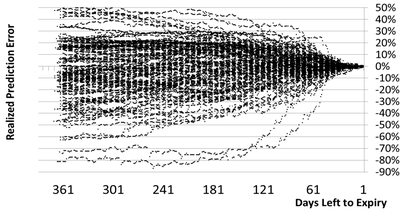
Unlike corn and wheat, soybean futures seem to exhibit classical risk premiums paid to speculators holding long positions, i.e. over long horizons, futures prices seem to be downward biased forecasts of terminal spot prices. Interesting, and puzzling, an additional phenomenon is that in the time-to-maturity dimension, RPE means seem to follow 60-day cycle. That is a phenomenon thus far completely unnoticed by the literature and requires further research.

corn



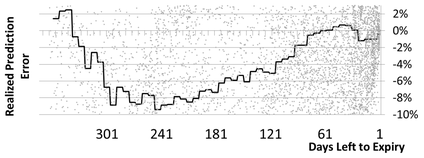
Although RPE means never reach above 3% when calculated in the time-to-maturity dimension, looking at the seasonal diagram reveals strong seasonality. In the first part of the year risk premiums are paid to holders of short futures positions. That effect vanishes in early July, and futures prices remain on average unbiased for the rest of the year.

class III milk



Unlike corn, soybeans and wheat, milk futures are cash settled based on a specified formula. For that reason, we see the prediction power of futures prices dramatically increasing in the last 2 months to maturity. Means of realized prediction errors are remarkably close to zero for up to 6 months to maturity, declining to -4.5% for 12 months to maturity. Although this market is much thinner than the others analyzed, we see no clear detrimental impact on the prediction power of futures prices.

sweet crude oil



The series shown above includes only 8 years of data (2002-2009), so it may be too short to reveal characteristics of light crude oil futures prices. What we see thus far is an extreme asymmetry in realized prediction errors and there seems to be a nonlinear risk-premium increasing up to –10% 8 months to maturity, but vanishing for 12 months to maturity.