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Hedging Simplified by Automation

THE UNIVERSITY OF ARIZONA
COLLEGE OF AGRICULTURE & LIFE SCIENCES
Agricultural & Resource Economics

Roger D. Dahlgran
The University of Arizona

Introduction

The hedging literature consists of various combinations of hedge targets, sample periods, hedge horizons, hedge types (single commodity vs complex hedges) and error specifications (ARIMA, GARCH, and error correction, etc.). Some applications include

- inventory hedging for corn, wheat, and cotton;
- process hedging for soybean crushing, ethanol refining, cattle and hog feeding; and
- cross-hedging for cottonseed crushing, for hops, sugar beets, and buffalo.

Recent literature has applied increasingly sophisticated and time varying hedge-ratio estimators, applied hedging to novel commodities, and applied hedging to difficult-to-get or carefully defined data. Practitioners, however, continue to use basic hedging methods. Ethanol plant managers and grain merchandisers indicate they use one-to-one hedging and typically assume basic error specifications in hedge-ratio estimation.

This gap between research and practice results from rational economic calculus. Specifically,

- the opportunity cost of managers' time is high,
- significant time investments are necessary to understand complex hedging techniques,
- data collection and analysis is time consuming,
- increment risk reduction attributable to sophisticated techniques is low, and
- managers need strategies that are time, form, space, and firm specific as well as current.

Perhaps automating the hedge-ratio estimation process can bridge the gap between theory and application.

Objectives

To determine the potential for automating hedge ratio estimation using generally accepted price risk minimization hedging theory. Automation must be achieved by parameterizing the hedge-ratio estimation process so that a wide variety of hedging problems can be represented. Parameters required for a specific application include the physical commodities, cash-market positions, the hedge horizons, hedge frequency, hedge vehicles, futures maturities, sample periods, sample frequencies, and error behavior.

Methods

One unit futures per unit spot (a.k.a, one-to-one or naive hedging).

1. Pros—data analysis not required.
2. Cons
   a. Futures contracts don't exist for some commodities.
   b. Not minimum price risk.

Minimum variance hedge ratios.

- Portfolio: spot (X_s) and attendant futures (X_f) positions.
- Portfolio gain/loss:
  $\pi = X_s \Delta S + X_f \Delta F$. X_s, S, X_f, F can be vectors.
- Input-output model:
  $X_S = \lambda X_{S0}$ with input/output coefficients λ.
  - $\lambda\Delta S$ is processing margin per unit of X_{S0}
  - Ex 1 bu soybeans gives 11 lbs of oil and 48 lbs of meal
- Risk-minimization:
  $\beta = X_f / X_{S0} = - \text{Cov}(\Delta F)^{-1} \text{Cov}(\Delta F, \lambda\Delta S)$
- Hedge ratio regression $\lambda\Delta S_t = \alpha + \beta\, \Delta F_{Mt} + \varepsilon t$ t = 1, 2, …T
  - Hedge ratios: $\hat{\beta}$
  - Hedge effectiveness: R^2 (proportionate risk reduction)

Pros

- minimizes price risk,
- elegant theory, and
- applies to any commodity, over any time, across product forms, space.

Cons

- costly application.

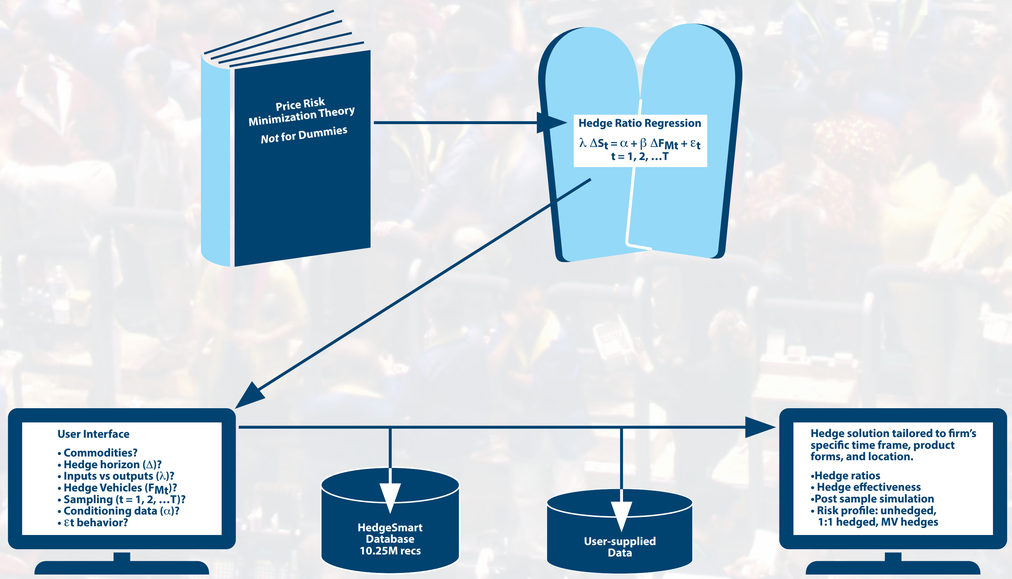
To estimate cost, a hedging ratio estimation thought-experiment was conducted with agricultural economists who specialize in the study of futures markets.

Thought Experiment Description

An alum of your program from 10 years ago is employed as a manager for a firm that owns five ethanol refineries in west-central Nebraska. The plants are widely dispersed and use sorghum as the feedstock.

Your department was contacted in hopes of obtaining advice on how to manage price risk. Your department head passed the request to you because of our interest and expertise in futures markets. If handled correctly, this request could become a consulting contract.

Before we get back to the client we want to give some thought to a contract that we might propose. At this stage we need only preliminary estimates of the time involved and the timeline for the study.



Results

Summary of Thought Experiment Responses

	Obs	Avg	Min	Max	Median
Billable hours	16	167.5	24.3	426.0	159.3
Cost of academic study	15	$16,417	$2,500	$35,000	$15,000
Cost of consulting study	12	$33,750	$4,000	$125,000	$23,750
Days to complete analysis	16	61	16	132	60

These results indicate that risk minimization is costly.

HedgeSmart© software determines the optimal hedging strategy by combining user-supplied, business-specific data with the generally accepted price-risk minimization model and an up-to-date database containing more than 10 million records on commodity price movements. You can use your own historical commodity prices to insure that the analysis reflects specific location, grade, and pricing characteristics as appropriate to your firm. The time and costs savings that HedgeSmart achieves enables analysts to ask "what-if" questions, to explore alternative hedging approaches, and to maintain closer customer relationships.

Hedge ratios and hedge effectiveness are reported in a matter of seconds. The program graphically depicts hedged, unhedged, and one-to-one hedging outcomes over the sample period. If unused data are available, the program simulates hedged, unhedged and one-to-one hedged outcomes over the post sample period to validate your results.

Conclusions

This research indicates that finding the minimum variance hedge ratio is costly, and is likely the most costly part of the hedging transaction. This is not recognized in academic hedge-ratio estimation studies. The marginal cost vs marginal benefits of sophisticated hedge ratio estimation techniques merits further investigation.

Automation can significantly reduce hedging costs and the marginal cost of risk reduction. This research has identified the steps in the hedge ratio estimation process. This process forms the basis for automation. HedgeSmart, a prototype of an automated hedging tool has been developed and is available at **http://HedgeSmart.net**. A fully functioning beta version is in the works. We are seeking beta testers.