

Price Volatility, Margin Calls and Hedging Decisions

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Introduction

- Hedging should be a major risk management tool
- BUT.. the use of futures contracts by farmers is less than expected from theory
- Why is hedging not then a preferred strategy by farmers?

Introduction

Simple hedging models ignore several factors

1. Basis Risk

- Expectations of futures price and cash price are unlikely to correspond exactly.

2. Transaction Costs

- Participation requires time and money.

3. Production Risk

- The exact amount available for sale (hedging) at end of season is unknown at planting.

4. Bias in Subjective Final Price Expectation

Introduction

- Farmers also face liquidity risk from margin calls
- Although final price movements may be small, price movements can be large within the contract period
- Example in 2008
 - Some elevators refused to offer forward contracts to farmers due to liquidity risk

Purpose

- To examine the implications of rising pricing volatility on optimal hedge ratio with liquidity risk considered.
- A 2-period model with 3 trading dates is derived and simulated.

Basic Optimal Hedging Model

- The farmer's profit at the end of year 1

$$\pi = \bar{p}\bar{q} + h(f_0 - f_2) - C_V(\bar{q}) - h\tau$$

Where

p - cash price at end of period

q - output

h -quantity of output hedged at beginning of period

f_i - futures price at time i ($i=0, 2$)

C_V - variable cost of production

τ - transaction costs of hedging

Hedging Model with Liquidity Risk

- The farmer's profit at the end of year 1

$$\pi = \bar{p}\bar{q} - h(\bar{r}_1 + \bar{r}_2 \mid r_1 \geq m) - C_V(\bar{q}) - h\tau$$

Where

p - cash price at end of period

q - output

h -quantity of output hedged at beginning of period

f_i - futures price at time i ($i=0,1,2$)

$r_1 = f_1 - f_0$ - futures price change between date 1 & beginning

$r_2 = f_2 - f_1$ - futures price change between date 2 & date 1

m - limit on future position loss before margin call

C_V - variable cost of production

τ - transaction costs of hedging

Model

- The optimal hedge ratio (h/q) is found by maximizing the certainty equivalent with respect to h

Optimal hedging ratio equation has 4 terms:

1. Speculative component
 - No speculation if $f_0 = f_2 + \tau$; speculation if $f_2 > f_0 + \tau$
2. Production risk effect
 - reduces hedge amount
3. Main hedging component
 - The lower the correlation between cash and futures price (greater the basis risk), the less that is hedged
4. Liquidity risk component
 - The greater the volatility in intermediate futures prices, the less that is hedged

Numerical Example

- Parameter values based on assumed values for Ontario soybean farmer

Expected cash price at end of period (p)- 9.00

Expected output (q)- 4500

Date 0 futures price (f_0)- 9.39

Date 2 futures price (f_2)- 9.45

Future price volatility - 0.135

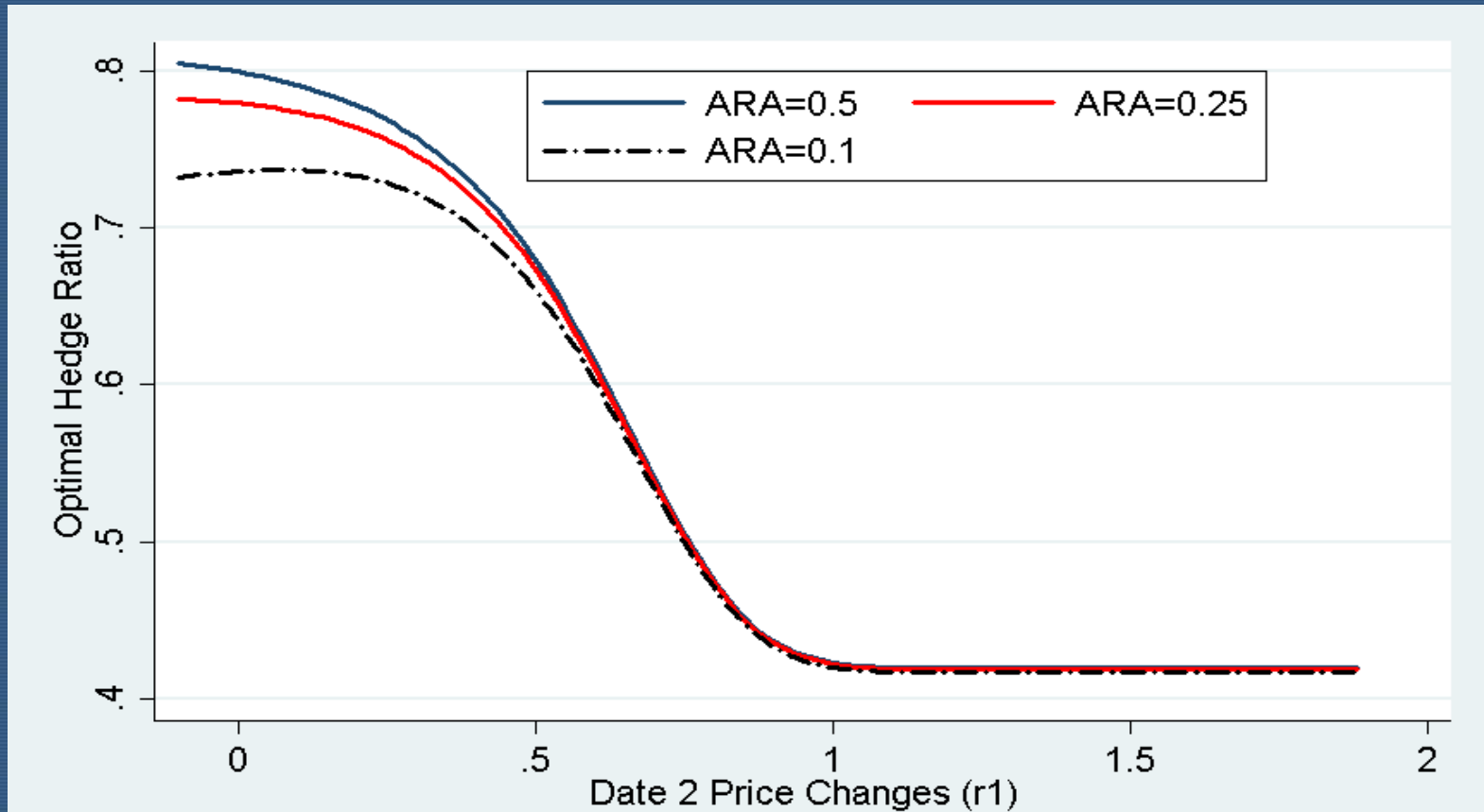
Std deviation of output- 0.15

Correlation (covariance) between p and f_2 0.99 (0.015)

Initial margin deposit- 4050

Results

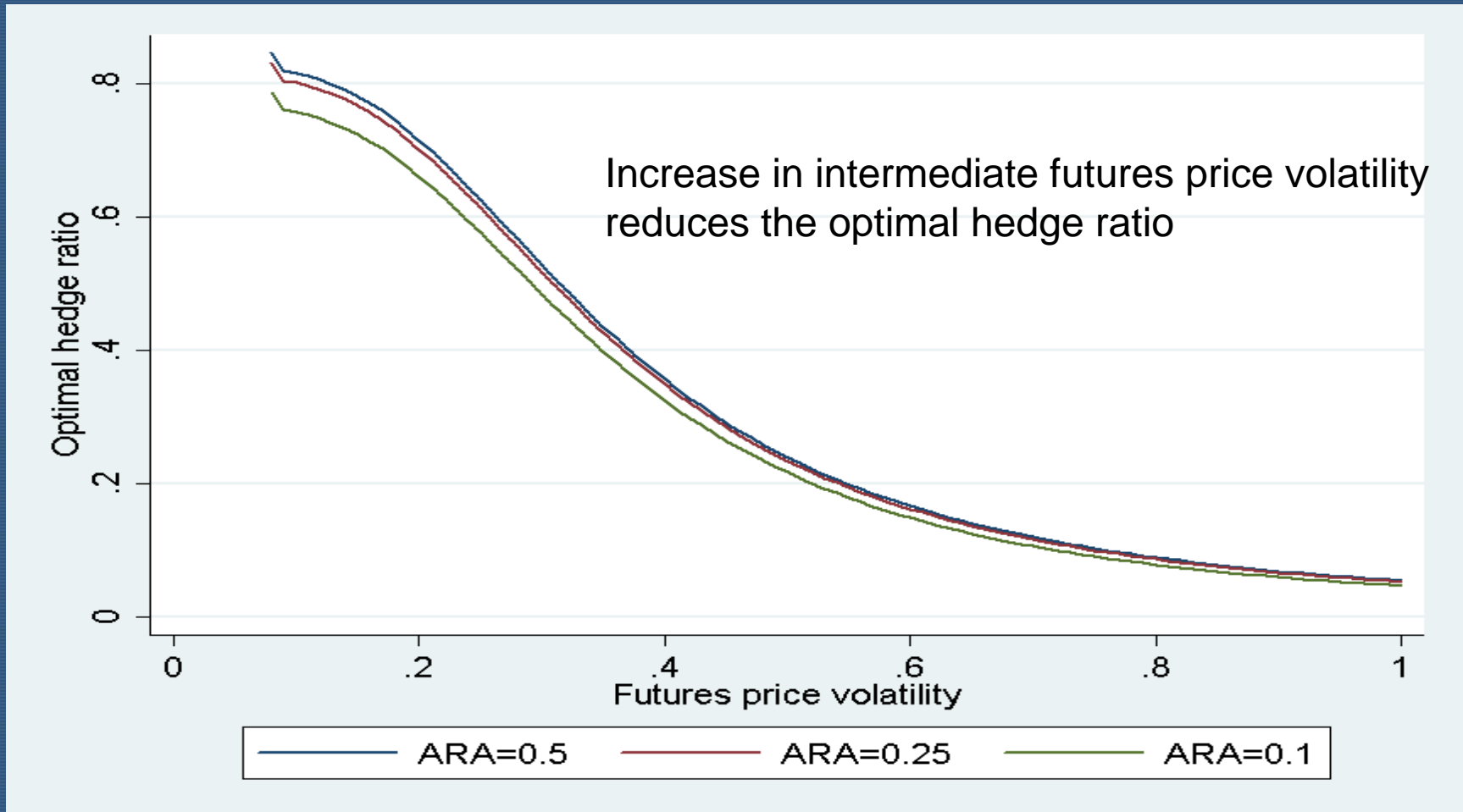
Figure 1. Date 2 Price Expectations (r_1), Degree of Risk Aversion (ARA), and Optimal Hedge Ratios



Expectation of margin call reduces hedge ration

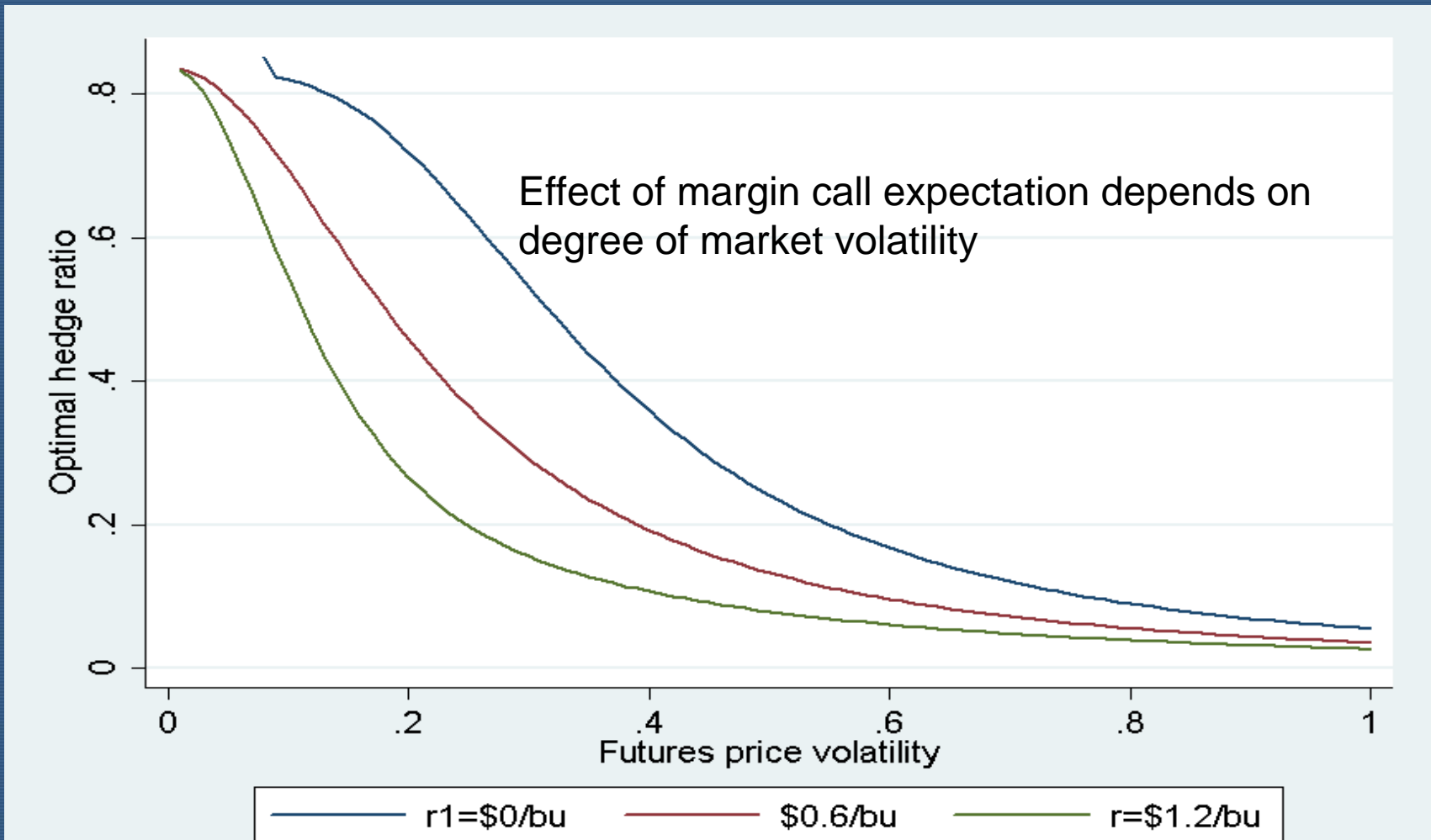
Results

Figure 2. Future Market Price Volatility, Degree of Risk Aversion and Optimal Hedge Ratios



Results

Figure 3. Date 2 Price Expectations (r_1), Future Market Price Volatility, and Optimal Hedge Ratios



Other Results

- Optimal hedge ratio is sensitive to changes in price expectations
- Risk aversion reduces the sensitivity of hedging to price expectations
- Gain in utility (CE) from use of futures is very small
- Small effect from changes in
 - production risk, and
 - transaction costs.

Conclusions

- Optimal hedge ratio will fall with
 - Intermediate price volatility
 - Risk of receiving a margin call
- Price expectations about basis and margin have a major impact on hedge ratio
 - especially for farmers not highly risk averse
- Extend work to include the effect of exchange rate volatility.