When Is It Best Not to Hedge Risk?

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Outline

- Risk Management and Hedging
- Examples: the Farmer and the Miner
- A Single Period Model
- Conclusions
Risk Management and Hedging

• What is a hedge?
  – Action designed to reduce risk of future outcome
  – In finance, perfect hedge leads to no risk (riskfree return)

• Use of hedges
  – Allow pricing of financial derivatives
  – Lead to markets in derivatives
  – Also possible with operations (operational hedges)
    • Quantity - flexible production
    • Timing
Who Should Hedge?

• Farmers?

• Situation:
  – Suppose either high-yield low-yield years for crops
  – Prices down in high years and up in the low years

Price

Quantity

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Farmer’s Example

• Suppose yield of corn is either 200 k-bushels (high) or 100 k-bushels (low)
• Suppose price with high yield is $1 and price with low yield is $2
• Should the farmer use financial hedge? i.e., sell a future?
  – If so, how much?
Futures Contracts as Hedges

- *Futures contract*: an agreement to buy or sell a fixed quantity at given price at fixed time in future (marked to market every day)
- Example: can agree to sell 100 k-bushels at $1.50/bushel on October 15
- On October 15, we receive $150K and must deliver 100 k-bushels
Futures for the Farmer

• Advantages
  – Can accept the expected price now
  – No risk in the price for the amount we sell

• Potential problems
  – Risk on amount we can produce
  – May have to go into market

• Analysis: Hedge our expected yield (150 k-bushels)
  Guaranteed (all the time)      $225K
  High yield – can sell 50 more  + $50K (probability ½)
  Low yield – must buy 50        -$100K (probability ½)
  Expectation=225+50/2-100/2= $200k (same as no hedge)
  BUT variance (risk) is up (either $275k or $125 instead of $200k all the time)

• RESULT: should not use futures (alone)
Farmer’s Operational Hedge for Risk Management

• What else does the farmer have?

• SILO!!
  – Operational hedge
  – Keep corn from high yield to sell at low yield

• Now, suppose we keep 50 k-bushels in silo from high to low yield years
Farmer’s Silo Hedge

• Expected returns
  – High-yield years (prob. ½) $150 k
  – Low-yield years (prob. ½) $300 k
  – Expectation: ½(150+300)= $225k
  – Worth $225k-200k =$25k to use the silo
  – Value of the operational hedge (option value of silo)

• Combine with future?
  – Now, sell 150 k-bushels for $1.50 in October
  – Now, have the return guaranteed $225K

• Moral: Financial instrument only has value if farmer uses operational hedge
Copper Miner’s Example

• Should a copper mine hedge its output with futures?
• What is the nature of copper price differences?
• Demand versus supply curve change means high price-high quantity and low price-low quantity
Copper Hedging

• Suppose high demand leads to 200 k-pounds at $2/pound and low demand leads to 100 k-pounds at $1/pound
• Earn $400k (prob. ½) or $100k (prob. ½)
• Expected value of $250k
• Operational hedge? (save 50 k-lbs from high to low years?)
  – High years: earn $300k (prob. ½)
  – Low years: earn $150k (prob. ½)
  – Expectation: $225k (lower value!)
Copper Futures?

• Suppose we sell 200 k-lbs at $1.50 in future

• Result now:
  – Futures return: $300k (all the time)
  – High demand: + $0k (with probability ½)
  – Low demand: - $100k (with probability ½)
  – Expectation: $250k
  – Risk reduced ($300 or $200 v. $400 or $100)

• Here: financial derivatives give value (how much? present value?)
Model for Single Period

• Suppose:
  – Price: $p(\omega)$
  – Cost: $c$
  – Max sales: $l+kp(\omega)$ ($k>0$ or $<0$)
  – Decision: $x$ (amount to hedge)

• Objective

$$\max (E(p) - c)x + E[(p-c)^+ (l+kp-x)^+$$
$$+ (c-p)(l+kp-x)^-]$$
Single Period Results

• When does hedging add value?
  – For $k < k^*$, hedge.
  – For $k \geq k^*$, do not hedge.

• When prices are supply-driven, hedging can be beneficial in securing higher prices when demand is high.

• When prices are demand-driven, hedging can negate the value of potential cost advantage over the market.
Overall Observations

• Farmer:
  – Financial and operational together

• Miner:
  – Financial alone (but only for risk reduction)

• One-period model
  – Hedging when correlation of price and quantity is below a threshold
Conclusions and Extensions

• Operations can affect value of hedging
• Price and quantity correlations determine hedging value
• Extensions to integrated model with production, inventory, and hedging decisions