A Margin Risk Approach to Risk Analysis and Risk Management in Agriculture

Dr. Jay Noel, Chair, Agribusiness Department
Steven Slezak, Lecturer, Agribusiness Department
College of Agriculture, Food, and Environmental Sciences
Cal Poly, San Luis Obispo, California

Palisade Risk Conference
Las Vegas, Nevada
Thursday, 8 November 2012
Two (Related) Types of Ag Risk

• Operations and Financing
  – price, cost, and yield
  – debt (including interest expense)

• Debt Financing Links Them
  – operational debt for cultural costs
  – debt incurred to cover thin or negative margins

• Address Margin Risk Perspective
  – revenue is volatile; function of price and yield
  – costs are less volatile
  – margin risk results
Managing Margin Risk

• Operational and Financial Risks Intersect in Margins
  – low prices, high costs, low yield
  – margins indicative of risks in other areas
  – manage margins and address broader risk issues

• Important Strategic Function
  – success or failure can depend on margin management strategy
The Case
The Case

- Iceberg Lettuce Grower and Shipper
  - leases 1500 acres in Salinas Valley
  - two harvests a year
  - 850 cases per acre average
  - borrows 50% of cultural costs
  - rule of thumb: hedge 80% of production
The Problem

- Farm Credit Wants Operator to Manage Margins
  - default risk too high
  - operational (not credit) issue
  - condition of credit
  - manages risk to revenue using forwards
    - no management of risk to costs
  - hedge ratio insufficient
For Purposes of This Simulation

• Margin
  – revenues less all costs
    • costs include debt service (P & I)
  – similar to debt service coverage
  – margin is what’s left over

• Margin Risk
  – chance that annual debt service (P&I) will not be covered, triggering a default event
Revenues Driven by Spot and Yield

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Spot Price</th>
<th>Yield (40 lbs per carton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>$8.10</td>
<td>850</td>
</tr>
<tr>
<td>2005</td>
<td>$7.93</td>
<td>804</td>
</tr>
<tr>
<td>2006</td>
<td>$10.75</td>
<td>725</td>
</tr>
<tr>
<td>2007</td>
<td>$12.38</td>
<td>830</td>
</tr>
<tr>
<td>2008</td>
<td>$11.93</td>
<td>824</td>
</tr>
<tr>
<td>2009</td>
<td>$9.08</td>
<td>928</td>
</tr>
<tr>
<td>2010</td>
<td>$12.88</td>
<td>983</td>
</tr>
<tr>
<td>Mean</td>
<td>$10.44</td>
<td>849</td>
</tr>
</tbody>
</table>

Correlation Matrix

<table>
<thead>
<tr>
<th></th>
<th>Yield</th>
<th>Average Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield (40 lbs per carton)</td>
<td>1</td>
<td>0.2082</td>
</tr>
<tr>
<td>Average Spot Price</td>
<td>0.2082</td>
<td>1</td>
</tr>
</tbody>
</table>

Forward Contract Prices Vary with Spot Price Between $11.50 and $12.50 on Sliding Scale ($0.25 Increments)
Total Revenue, 50% Leverage, $12.50 Contract

Regression Coefficients

+Yield / Stochastic (Empirical Distribution) 0.94

+Price / Stochastic (Empirical Distribution) 0.33
# Harvest Costs Variable (Driven by Yield); Cultural Costs Fixed

Production Costs (per Acre, Single Harvest)

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>$144.00</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>$359.00</td>
</tr>
<tr>
<td>Weed Control/Thinning Labor</td>
<td>$146.00</td>
</tr>
<tr>
<td>Pest Management (includes PCA costs)</td>
<td>$582.00</td>
</tr>
<tr>
<td>Water</td>
<td>$280.00</td>
</tr>
<tr>
<td>Irrigation Labor</td>
<td>$241.70</td>
</tr>
<tr>
<td>Tractor Labor</td>
<td>$148.35</td>
</tr>
<tr>
<td>Fuel</td>
<td>$172.93</td>
</tr>
<tr>
<td>Tractor and Machinery Cost</td>
<td>$255.58</td>
</tr>
<tr>
<td>Supervision and General Labor</td>
<td>$105.00</td>
</tr>
<tr>
<td>Compost</td>
<td>$50.00</td>
</tr>
<tr>
<td>Total Cultural Costs</td>
<td>$2,484.56</td>
</tr>
<tr>
<td>Fresh Market Harvest Cost ($/Carton)</td>
<td></td>
</tr>
<tr>
<td>Cut/Pack/Haul</td>
<td>$5.85</td>
</tr>
<tr>
<td>Average Yield/Acre (Cartons)</td>
<td>850</td>
</tr>
<tr>
<td>Total Harvest Cost (cooling, palletize, and sell) per acre</td>
<td>$4,972.50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Production Costs</td>
<td>$7,457.06</td>
</tr>
<tr>
<td>Cash Overhead per acre</td>
<td>$130.00</td>
</tr>
<tr>
<td>Land Rent per Acre</td>
<td>$1,100.00</td>
</tr>
<tr>
<td>Interest on Operating Capital (based on 6.275% per year on half of cultural cost)</td>
<td>$38.98</td>
</tr>
<tr>
<td>Total Overhead Cash Cost</td>
<td>$1,268.98</td>
</tr>
<tr>
<td>Depreciation and Interest on Investments</td>
<td>$50.00</td>
</tr>
<tr>
<td>Total per Acre Cost</td>
<td>$8,776.04</td>
</tr>
<tr>
<td>Total Cost less Harvest Cost</td>
<td>$3,803.54</td>
</tr>
</tbody>
</table>
The @Risk Simulation
Technical Specifications

- **@Risk Functions**
  - RiskNormal
    - yield driving harvest costs
  - RiskGeneral
    - spot price and contract price
    - yield driving revenues
  - 500 simulations
- **@Risk for Excel 6.0.0 (Industrial Edition)**
- **MS Excel 2010, Windows 7**
- **Oracle VM VirtualBox Manager 4.1.23**
- **iMac (3.1 GHz Intel Core i5)**
Cash Market Price (rsk gen)

- Minimum: $7.9386
- Maximum: $12.8791
- Mean: $10.4259
- Std Dev: $1.4187
- Values: 500
100% Hedge, 50% Leverage, $12.50 Contract

\[ \sigma_{\text{Revenue}} = $894 \quad \sigma_{\text{Cost}} = $492 \]
No Hedge, 50% Leverage

$\sigma_{\text{Revenue}} = $1464

$\sigma_{\text{Cost}} = $498
Net Income with 50% Leverage

Cum Probability

Net Income

All Hedge, $12.50 Contract
Net Income with 50% Leverage

Cum Probability

Net Income

- $5,000
- $3,000
- $1,000
$1,000
$3,000
$5,000

All Hedge, $12.50 Contract
All Hedge, $10.50 Contract
The Hedge

Oh merde!
The Hedge

• Analysis Says 100% Hedge is Sensible

• In Practice, 80% Hedge Ratio
  – acting as though contract price is $11.25
  – locking in a reduction in net income

• Why Take the Risk?
  – retail market and supply chain dynamics
  – strategy not focussed on minimizing margin risk
  – trading upside for chance at extra $150 per acre
  – self-insured; moral hazard; “What the hell?” attitude
80% Hedge Ratio (@ $11.25 Contract Equivalent)

Cum Probability

Net Income

-5,000 -4,000 -3,000 -2,000 -1,000 0 1,000 2,000 3,000 4,000 5,000 6,000

All Hedge, $11.25 Contract
No Hedge
100% Hedge, 50% Leverage, $11.25 Contract
Cum Probability of Net Income with 50% Leverage

- Blue line: All Hedge, $12.50 Contract
- Green line: All Hedge, $11.25 Contract
- Red line: No Hedge

Net Income Range: $-5,000 to $6,000
Cumulative Probability: 0% to 100%
The Forecast
The Forecast

- @Risk Functions
  - RiskNormal (as before)
  - RiskGeneral (as before)
  - RiskTriang (0,0.0074721,0.0074721)
    - cultural costs grow at maximum annual rate of 1.5%
  - 500 simulations
Forecast Net Income: 2012a to 2017b

Cum Probability

- All Hedge 2012a
- No Hedge 2012a
- All Hedge 2017b
- No Hedge 2017b
Net Income Forecast: Harvests 2012a to 2017b

- Mean
- +/- 1 Std. Dev.
- 5% - 95%
Reconsider Understanding of Risk

• Look Beyond Revenue Side
  – prices, yields, revenue require management

• What About Costs?
  – land, fertilizer, energy, water, seed, weather, pests, disease, regulations, technology, food safety, foreign currency
  – major sources of risk
  – all require management
Reconsider Our Treatment of Risk

- Mistake to Focus Mainly on Prices
  - ignores effect of financing and capital costs
- Must Focus on Revenues and Costs -- Margins
- Margin Risk Management is Key Strategic Competence
Hope is Not an Option

• Risk Management is a Strategic Function
  – part of competitive advantage
    • or lack thereof
  – major component of management responsibility
    • just like operations, harvest, distribution, sales
    • operations and finance intersect in margins
    • integral part of strategic activities
  – needs daily attention, high level of expertise, and good information
  – contributes to success or failure of company
Strategic Implications for Industry

- More Broadly:
  - prepare to adapt and change
  - in other words, research, develop, innovate

- There Will be Failure; Risk Taking Required
  - small scale failure (no catastrophes)
  - fail quickly, learn, move on
  - risk management more important than ever

- Innovation Creates Value
  - share benefits with customers
  - share risks with customers, too
Data Sources

- University of California Cooperative Extension (2009)
- USDA Agricultural Marketing Service Market News
- Monterey County (CA), Office of the Agricultural Commissioner
- Proprietary Sources
Contact Information

For additional information on the Agribusiness program at Cal Poly, please contact:

Dr. Jay Noel, Chair
Steven Slezak, Lecturer

Agribusiness Department
College of Agriculture, Food and Environmental Sciences
Cal Poly University
San Luis Obispo, California  93407
Phone:  805-756-5008
E-mail:  jnoel@calpoly.edu
         sslezak@calpoly.edu