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

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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 (40 lbs per carton)</th>
<th>Yield</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 Spot Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield</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
### Production Costs (per Acre, Single Harvest)

- **Seed**: $144.00
- **Fertilizer**: $359.00
- **Weed Control/Thinning Labor**: $146.00
- **Pest Management (includes PCA costs)**: $582.00
- **Water**: $280.00
- **Irrigation Labor**: $241.70
- **Tractor Labor**: $148.35
- **Fuel**: $172.93
- **Tractor and Machinery Cost**: $255.58
- **Supervision and General Labor**: $105.00
- **Compost**: $50.00
- **Total Cultural Costs**: $2,484.56
- **Fresh Market Harvest Cost ($/Carton)**
  - **Cut/Pack/Haul**: $5.85
  - **Average Yield/Acre (Cartons)**: 850
  - **Total Harvest Cost (cooling, palletize, and sell) per acre**: $4,972.50
- **Total Production Costs**: $7,457.06
- **Cash Overhead per acre**: $130.00
- **Land Rent per Acre**: $1,100.00
- **Interest on Operating Capital (based on 6.275% per year on half of cultural cost)**: $38.98
- **Total Overhead Cash Cost**: $1,268.98
- **Depreciation and Interest on Investments**: $50.00
- **Total per Acre Cost**: $8,776.04
- **Total Cost less Harvest Cost**: $3,803.54
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 (risk gen)

Minimum: $7.9386
Maximum: $12.8791
Mean: $10.4259
Std Dev: $1.4187
Values: 500
$6,000  $7,000  $8,000  $9,000
$10,000  $11,000  $12,000  $13,000

Sim Results

100% Hedge, 50% Leverage, $12.50 Contract

σ_{Revenue} = $894  σ_{Cost} = $492
No Hedge, 50% Leverage

\[ \sigma_{\text{Revenue}} = $1464 \quad \sigma_{\text{Cost}} = $498 \]
Net Income with 50% Leverage

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

- Cum Probability
- Net Income

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)
100% Hedge, 50% Leverage, $11.25 Contract
P&L For Resulting Hedge

Net Income

Cum Probability

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

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 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

$ -5000  -4000  -3000  -2000  -1000  0  1000  2000  3000  4000  5000

- $ 5000  $ 4000  $ 3000  $ 2000  $ 1000  $ 0

Hedges:
- All Hedge 2012a
- No Hedge 2012a
- All Hedge 2017b
- No Hedge 2017b
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

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