

## **5. Understanding Credit Quality**

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*Professor Featherstone is recognized as a leading scholar in agricultural finance. His work has resulted in teaching and research awards as well as quotation in the Wall Street Journal and other popular publications. He served as an Associate Editor for the American Journal of Agricultural Economics and on the editorial board of Choices. He has more than 90 articles published in journals such as The Review of Economics and Statistics, American Journal of Agricultural Economics, Review of Agricultural Economics, Applied Economics, and Agricultural Finance Review. Allen has international experience lecturing and researching in Europe, Asia, Africa, and South America.*

### **Abstract/Summary**

*The Kansas agricultural economy continues to experience profitability. However, the overall economy remains sluggish. This has led to concerns regarding the tightening of credit in the agricultural sector. Therefore, understanding factors consistent with high credit quality are important factors to understand. This presentation will discuss important financial ratios, the relationship between leverage, risk, and return, credit scoring models, and an update of farm level credit quality.*

## Understanding Credit Quality

Allen M. Featherstone  
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## Outline

- Definition of Important Financial Ratios
- Leverage, Risk, and Profit
- Credit Scoring Models
- Farm Level Credit Quality

## Important Profitability Ratios

$$\text{ROE} = \frac{\text{NFI} - \text{unpaid labor and mgmt} + \text{capital gains}}{\text{beginning equity}}$$

$$\text{ROE (after - tax)} = \frac{\text{ending equity} - \text{beginning equity}}{\text{beginning equity}}$$

$$\text{ROA} = \frac{\text{NFI} - \text{unpaid labor and mgmt} + \text{capital gains} + \text{interest}}{\text{beginning assets}}$$

## Important Leverage Ratios

$$\text{D/A} = \frac{\text{Total Farm Liabilities}}{\text{Total Assets}}$$

$$\text{E/A} = \frac{\text{Total Equity}}{\text{Total Assets}}$$

$$\text{D/E} = \frac{\text{Total Farm Liabilities}}{\text{Total Assets}}$$

## Important Liquidity Ratios

$$\text{Current Ratio} = \frac{\text{Total Current Farm Assets}}{\text{Total Current Farm Liabilities}}$$

$$\text{Working Capital Percentage} = \frac{\text{Current Assets} - \text{Current Liabilities}}{\text{Total Farm Assets}}$$

## Important Repayment Ratios

$$\text{CRDC} = \frac{\text{NFI} + \text{Nonfarm Income} + \text{Depreciation} + \text{Interest on Debt} - \text{Income Taxes} - \text{Family Living}}{\text{Annual Principal and Interest} + \text{Working Capital Deficiency} + \text{Capital Asset Replacement}}$$

$$\text{Debt Coverage} = \frac{\text{NFI} + \text{Nonfarm Income} + \text{Depreciation} + \text{Interest on Debt} - \text{Income Taxes} - \text{Family Living}}{\text{Annual Principal and Interest} + \text{Capital Leases}}$$

## Risk and Profit and Leverage

## Risk and Profit and Leverage

In theory . . .

- To obtain higher profit, the farmer must bear higher risk
- To obtain lower risk, farmers must sacrifice profit

## Profitability Relationships

$$R_E = \frac{R_A - K}{1 - (D/A)} + K$$

$R_E$  = Average rate of return on equity  
 $R_A$  = Average rate of return on assets  
 $D/A$  = Debt to asset ratio  
 $K$  = Average interest rate

## Profitability Relationships

$$R_E = \frac{R_A - K}{1 - (D/A)} + K$$

- Leverage increases profit . . .
- Only if returns on assets are greater than the interest rate

## Risk Relationships

$$S_E^2 = \frac{S_A^2 + S_K^2 + S_{A,K}}{[1 - (D/A)]^2}$$

$S_E^2$  = Variance of Equity

$S_A^2$  = Variance of Assets

$S_K^2$  = Variance of Interest Rate

$S_{A,K}$  = Covariance of Assets and Interest Rate

## Risk Relationships

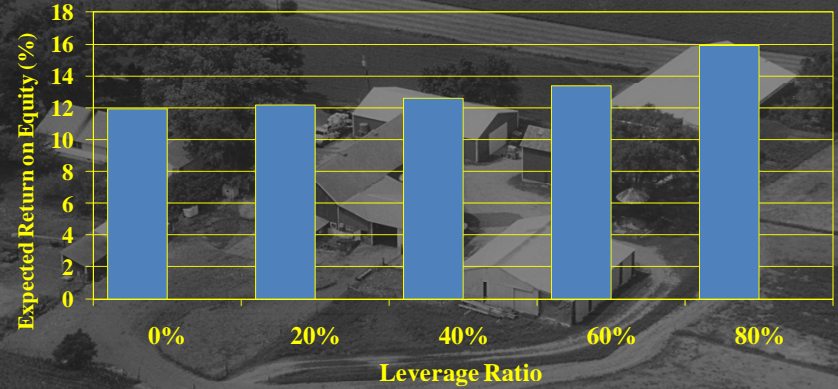
$$S_E^2 = \frac{S_A^2 + S_K^2 + S_{A,K}}{[1 - (D/A)]^2}$$

- Increases in the variability of asset returns increases variability in equity returns (probability of loss)
- Same story for variability in interest rates
- Leverage increases probability of loss at an increasing rate

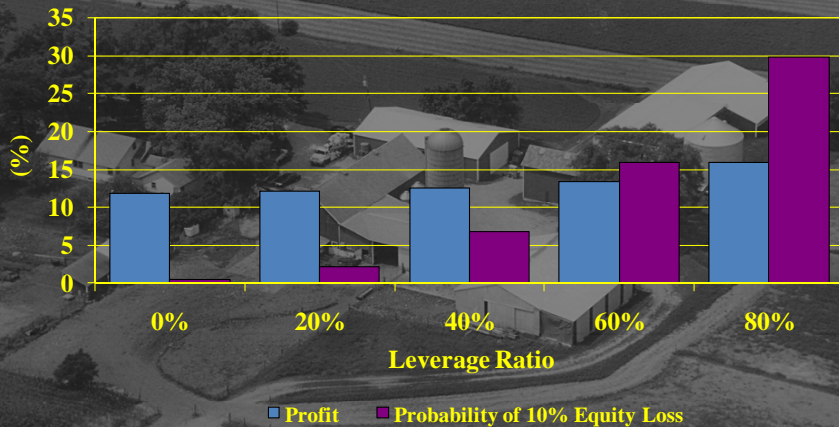
# Profit and Risk and Leverage

Debt to Asset Ratio Base Case <sup>a</sup>	Average Return on Equity	Standard Deviation on Return on Equity	Probability of Return on Equity Below			
			0%	-5%	-10%	-25%
0%	11.90%	8.47%	8.00%	2.30%	0.49%	0.00%
20%	12.15%	10.94%	13.33%	5.84%	2.14%	0.03%
40%	12.57%	15.09%	20.25%	12.22%	6.74%	0.64%
60%	13.40%	23.47%	28.40%	21.65%	15.94%	5.09%
80%	15.90%	48.72%	37.21%	33.40%	29.75%	20.06%

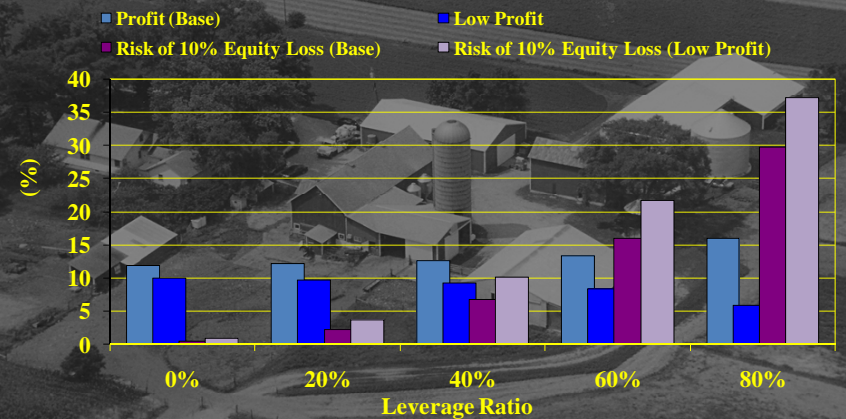
# Profit and Leverage



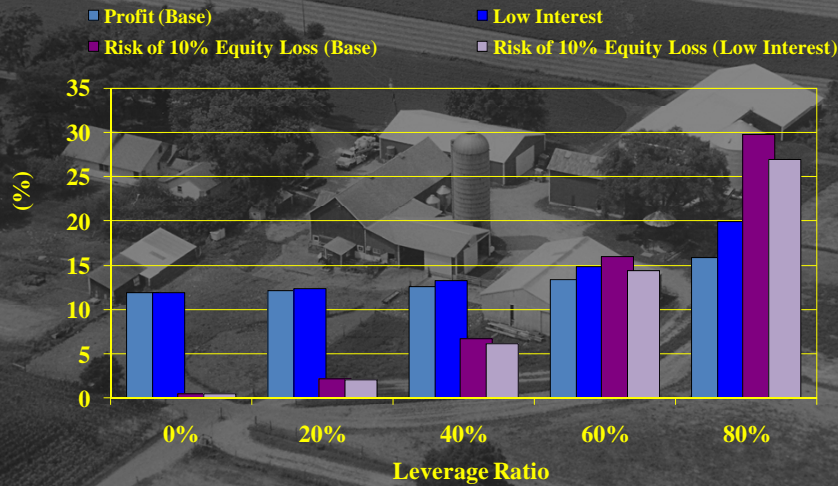
# Profit and Leverage and Risk



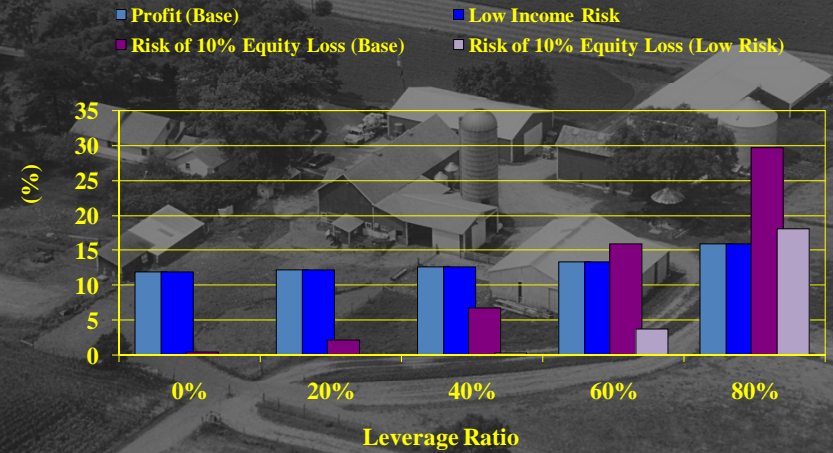
# Profit and Leverage and Risk Low Profit



## Profit and Leverage and Risk Low Interest Rates



## Profit and Leverage and Risk Less Income Risk



## Profit and Leverage and Risk

- **Leverage increases profit if the return on assets is greater than the borrowing cost**
- **Leverage increases risk at an increasing rate**
- **Risk and Profit trade-off determined by:**
  - return on assets
  - risk of farming operations
  - leverage
  - interest rates

## Credit Scoring Models

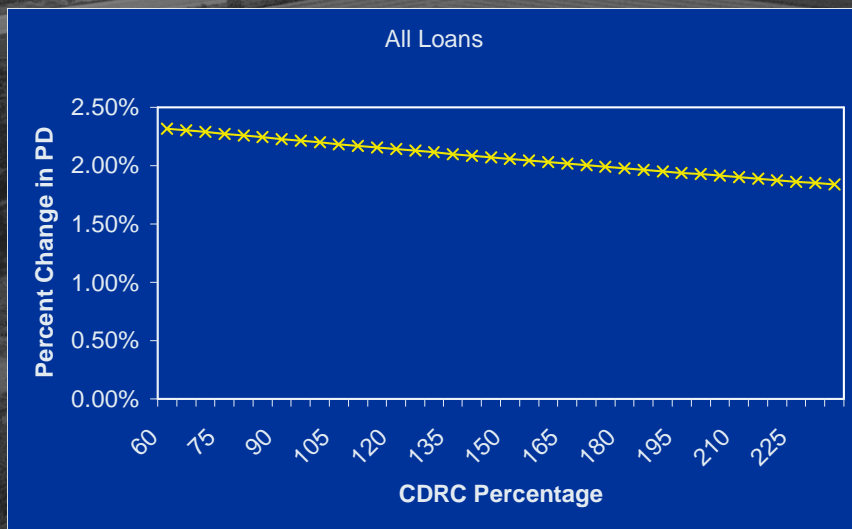
# Probability Model of Default

- Seventh Farm Credit District Loan Level Data
- 11 State Geographic Region
- “Snapshots” of Portfolio at Year Ends 1995-2002
- Loan Origination Data (157,853 loans)

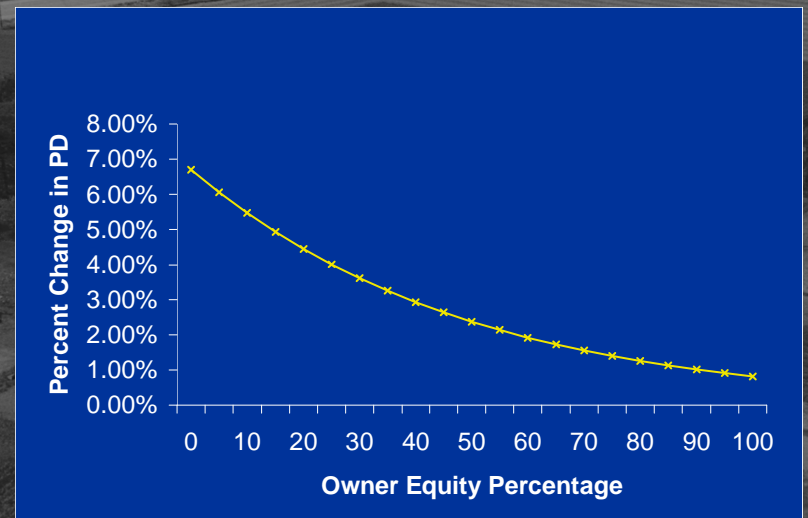
# Probability Model of Credit Quality

- Dependent Variable – Default
- Independent Variables – Repayment Capacity, Owner Equity, and Working Capital Percentages
- $xb = -2.3643 - 0.00135*CDRC - 0.0217*OEP - 0.00399*WCP$
- $prob = \frac{\exp(xb)}{1 + \exp(xb)} * 100$

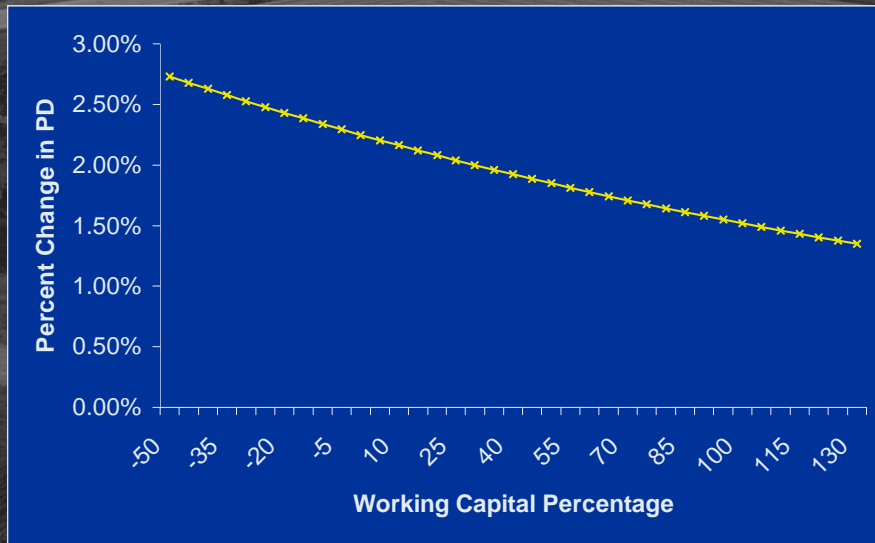
## Change in PD as CDRC Increases



## Change in PD as Owner Equity Increases



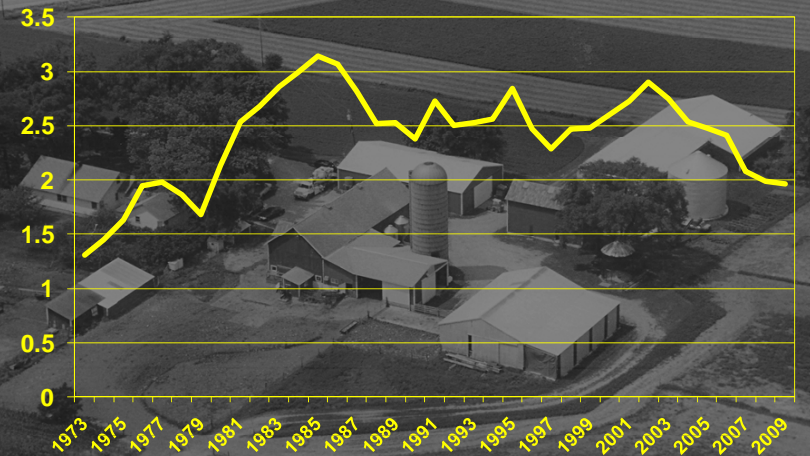
## Change in PD as Working Capital Increases



## Applying Credit Scoring Models to Kansas

- Calculated the ratios necessary to rate farms
- Kansas Farm Management Data from 1973 to 2009
- 1200 to 2000 observations per year
- Synthetically rated each Kansas farm

## Probability of Default for Kansas Farms



## Probability of Default for Kansas Farms



## What does it imply for borrowing cost?

Rating	1 yr	2 yr	3 yr	5 yr	7 yr	10 yr	30 yr
Aaa/AAA	14	16	27	40	56	68	90
Aa1/AA+	22	30	31	48	64	77	99
Aa2/AA	24	37	39	54	67	80	103
Aa3/AA-	25	39	40	58	71	81	109
A1/A+	43	48	52	65	79	93	117
A2/A	46	51	54	67	81	95	121
A3/A-	50	54	57	72	84	98	124
Baa1/BBB+	62	72	80	92	121	141	170
Baa2/BBB	65	80	88	97	128	151	177
Baa3/BBB-	72	85	90	102	134	159	183
Ba1/BB+	185	195	205	215	235	255	275
Ba2/BB	195	205	215	225	245	265	285
Ba3/BB-	205	215	225	235	255	275	295
B1/B+	265	275	285	315	355	395	445
B2/B	275	285	295	325	365	405	455
B3/B-	285	295	305	335	375	415	465
Caa/CCC+	450	460	470	495	505	515	545

## Distribution of Credit Quality



## Probability of Default by Farm Type

Farm Type (Observations)	2008	2009
Crop – Non Irrigated (930)	1.91	1.81
Crop – Irrigated (43)	1.67	1.57
Dairy (32)	2.50	2.77
Crop – Cow Herd (123)	1.94	1.90
General Farm (21)	1.43	1.56
Crop – Beef Background (26)	2.32	2.24
Crop – Beef (37)	2.14	2.37



## Conclusions

- **Increases in credit quality are rewarded in the bond market with lower interest rates.**
- **Movement from a B rating to a BB rating in the corporate market would suggest a decrease in interest rates of 1.40%**



## Conclusions

- **Leverage increases profit if the return on assets is greater than the borrowing cost**
- **Leverage increases risk and an increasing risk**



## Conclusions

- **Credit quality of Kansas farms is excellent from a historical perspective**
- **Credit quality generally improved slightly from 2008 - 2009**
- **However, dairy farms, general farms, and crop-beef farms saw a deterioration of credit quality**