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Do Farmer's Follow the DuPont Model? Factors Affecting a Farm's Capital Structure and Leverage

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Introduction

The DuPont model was created as a way to assess the financial position of a firm

- Operating Performance
- Financial Performance
- Provides a theoretical framework and roadmap for business and managerial decision making

Provides information for farm businesses to analyze and make decisions from

Introduction

Leverage has long been an interest of study

- How risk affects leverage (Barry and Robison, 1987; Collins, 1985; Escalante and Barry, 2001)
- Leverage and hedging (Turvey and Baker, 1988)
- Price support policies (Featherstone et al, 1988)
- Capital gains (Lowenberg-DeBoer and Boehlje, 1986)
- Capital gains deduction (Moss et al., 1989)
- Tax credit (Ahrendsen, 1994)

How does managerial decision making affect the capital structure of a farm?

Introduction

Extension programs have focused on farm profitability models

- Boehlje, Dobbins, and Gray (2004) examined effectiveness of an online e-learning tool in teaching the DuPont model
- Indeed many universities have extension publication on the DuPont model or closely related financial performance decision tool

If farmers follow the advice of the DuPont model, could help predict future debt levels in agriculture

Conceptual Model

DuPont Model

$$ROE = \frac{\text{Net Income}}{\text{Sales}} * \frac{\text{Sales}}{\text{Assets}} * \frac{\text{Assets}}{\text{Equity}}$$

Or

$$ROE = \text{Earns} * \text{Turns} * \text{Leverage}$$

Where

$$ROA = \text{Earns} * \text{Turns}$$

Key Relationship in DuPont

When $ROA > \text{Average Interest Rate (Cost of Debt)}$

- $ROE > ROA > AIR$
- At this point adding debt will increase ROE

Why?: Because the firm is making money on borrowed money thus increasing ROE

When $ROA < \text{Average Interest Rate (Cost of Debt)}$

- $ROA < AIR$
- In this case the firm is losing money on borrowed money

Previous work

Mishra, Moss, and Erickson (2009) looked at what factors of the DuPont model affected ROE and how this differed by ERS region.

Analysis of factors affecting each of the three components of the DuPont model (Mishra et al., 2012)

Moss, Mishra, and Dedah (2009)

Empirical Model

$$y_{it} = \alpha + \beta_i X_{it} + \delta_i DuPont + \varepsilon$$

where

$$y_{it} = \begin{cases} 1 & \text{if farm took on more debt} \\ 0 & \text{otherwise} \end{cases}$$

DuPont is a dummy such that

$$DuPont = \begin{cases} 1 & \text{if } ROA > AIR \\ 0 & \text{otherwise} \end{cases}$$

Linear model (Heckman Selection)

$$y_{it} = \alpha + \beta_i X_{it} + \delta_i DuPont + \gamma \lambda_i + \varepsilon$$

Empirical Model

Off Farm Financial

- Family Living Expenses
- Off Farm Income

Farm Cash Position

- Margin after Debt Service

Profitability

- Operating Expense Ratio
- Profit Margin

Output Efficiency

- Asset Turnover

Capital Structure

- Asset/Equity Ratio

Data

Data from the Farm Service Agency (FSA) compiled for its borrowers from 2005 to 2012

108,662 observations

FSA Data mainly made up of new and beginning farmers or farmers in financial distress.

Variable	Mean	Std. Dev.
Increase Debt	0.52	0.50
Gross Revenue	209,515.40	393,342.70
Net Income	39,367.99	97,215.72
Operating Expenses	126,227.30	280,745.10
Total Non Farm Income	31,218.74	44,168.24
Total Family Living Expense	28,184.13	21,833.36
Total Non Farm Expense	2,501.92	26,058.16
Repayment Capacity	53,129.59	99,631.07
Term Principal	24,326.13	44,186.01
Margin after Debt Service	15,932.82	80,017.41
Term Debt Coverage Ratio	2.87	216.59
Operating Expense Ratio	73.63	140.94
Return on Assets	2.43	25.61
Total Assets	603,952.00	867,464.40
Total Liability	296,599.00	432,692.20
Debt to Asset Ratio	53.03	34.31
ROA>Cost of Debt	0.50	0.50

Variable	ROA>Cost of Debt	ROA<Cost of Debt
Increase Debt	0.58	0.42
Gross Revenue	324,027.80	92,979.59
Net Income	73,693.98	4,435.50
Operating Expenses	189,150.80	62,191.91
Total Non Farm Income	16,933.99	45,755.89
Total Family Living Expense	25,379.39	31,038.44
Total Non Farm Expense	2,058.47	2,953.21
Repayment Capacity	81,485.05	24,273.11
Term Principal	36,246.37	12,195.27
Margin after Debt Service	27,593.43	4,066.17
Term Debt Coverage Ratio	2.58	3.17
Operating Expense Ratio	55.99	91.59
Return on Assets	14.59	(9.94)
Total Assets	782,311.90	422,440.70
Total Liability	405,390.20	185,885.60
Debt to Asset Ratio	56.90	49.10

DuPont Summary

	ROE	Profit Margin	Asset Turnover	Leverage Ratio
Full Sample	0.22%	0.13%	0.62	2.82
ROA>AIR	0.43%	0.18%	0.701	3.27
ROA<AIR	0.09%	0.07%	0.55	2.36

	Farm took on more debt
ROA>AIR	58%
ROA<AIR	42%

Results

Whether a farmer is using DuPont Analysis or not, those farmers that are making money on borrowed money are 24% more likely to increase debt level

Non-farm income and Family Living Expenses both increase probability of taking on additional debt

Profit margin, margin after debt service, and liquidity ratio all negatively correlated with adding additional debt

- Farmers use excess to just pay down debt

Debt Choice—Marginal Effects

Variable	Coefficient	Std. Dev.
Total Non Farm Income	0.000001 ***	0.000000
Total Family Living Expenses	0.000004 ***	0.000000
Operating Expense Ratio	0.000006	0.000010
Liquidity Ratio	(0.000001)***	0.000000
Margin After Debt Service	(0.000000)***	0.000000
Profit Margin	(0.024592)***	0.003340
Asset Turnover	0.001513 ***	0.000610
Asset to Equity	0.000027	0.000060
ROA>AIR	0.243698 ***	0.003400

Results

Lambda is statistically significant, the probability a farmer self selects into adding additional debt affects how much debt the farmer ultimately ends up adding.

Family Living Expenses positively correlated with amount of additional debt

Margin after debt service is negatively correlated with additional debt amount.

- The more cash on hand, the less debt you are going to acquire

ROA greater than cost of debt increases additional debt added by \$30,000

Debt Choice—Amount of Debt

Variable	Coefficient	Std. Dev.
Total Non Farm Income	(0.006)	0.006
Total Family Living Expenses	0.474 ***	0.026
Operating Expense Ratio	1.737	1.751
Liquidity Ratio	(0.002)	0.014
Margin After Debt Service	(0.072)***	0.002
Profit Margin	(583.173)	708.139
Asset Turnover	59.828	120.112
Asset to Equity	(1.827)	7.164
ROA>AIR	29,561.440 ***	1,908.348
Constant	(17,190.220)***	5,508.148

Conclusions

Farmers, whether actively or not, seem to be following the advice of the DuPont financial model. When Return on assets is greater than the cost of debt, it is correlated with a 24% increase in the probability a farmer acquires more debt

It's the relative profitability that matters, not just if the farmer has more money in bank account at end of year that has significant impacts on the debt decision.

Questions?

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