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

BRADY E. BREWER, CESAR L. ESCALANTE, HOFNER D. RUSIANA, CHARLES B. DODSON

NC-1177, MINNEAPOLIS, MN

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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

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

Or

$$ROE = Earns * Turns * Leverage$$

Where

$$ROA = Earns\ * Turns$$

# Key Relationship in DuPont

When ROA>Average Interest Rate (Cost of Debt)

- ◦ ROE>ROA>AIR
- ◦ At this pointing adding debt will increase ROE

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

When ROA<Average Interest Rate (Cost of Debt)

- ◦ ROA<AIR
- ◦ In this case the farm 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

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

DuPont is a dummy such that

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

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 Turnnover | 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 Turnnover | 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?

BEBREWER@UGA.EDU