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The Financial Performance of U.S. Farmer Cooperatives: A Quantile Regression Analysis of Efficiency, Productivity, and Leverage

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NCERA-210 Annual Meeting
Minneapolis, MN
11/02/2016

INTRODUCTION

- What is cooperative performance? (Soboh et al., 2009; Melia-Marti and Martinez-Garcia, 2015)

- Heterogeneous Objectives
  - Investor-Owned Firm — max $p_1y_1 + p_2y_2 - c(y)$
  - Supply Cooperative — min $w_1x_1 + w_2x_2$
  - Marketing Cooperative — max $p_1y_1 + p_2y_2$
  - Multi-Purpose Cooperative — ?

- Heterogeneity in Function, Structure, Sector, and Purpose

Recent Empirical Literature

- Two Approaches (Soboh et al., 2009)
  1. Financial Ratios
  2. Other

Author(s)	Setting	Methodology
Soboh et al. (2012)	Europe (dairy)	Data envelopment analysis
Kalogeras et al. (2013)	Netherlands	Principal component analysis
Melia-Marti and Martinez (2015)	Spain	Probit regression
Wouterse and Francesconi (2016)	Senegal, Ethiopia, Malawi	Two-stage least squares
Jardine et al. (2014)	Alaska (salmon)	Difference-in-differences
Benos et al. (2016)	Greece	Ordinary least squares

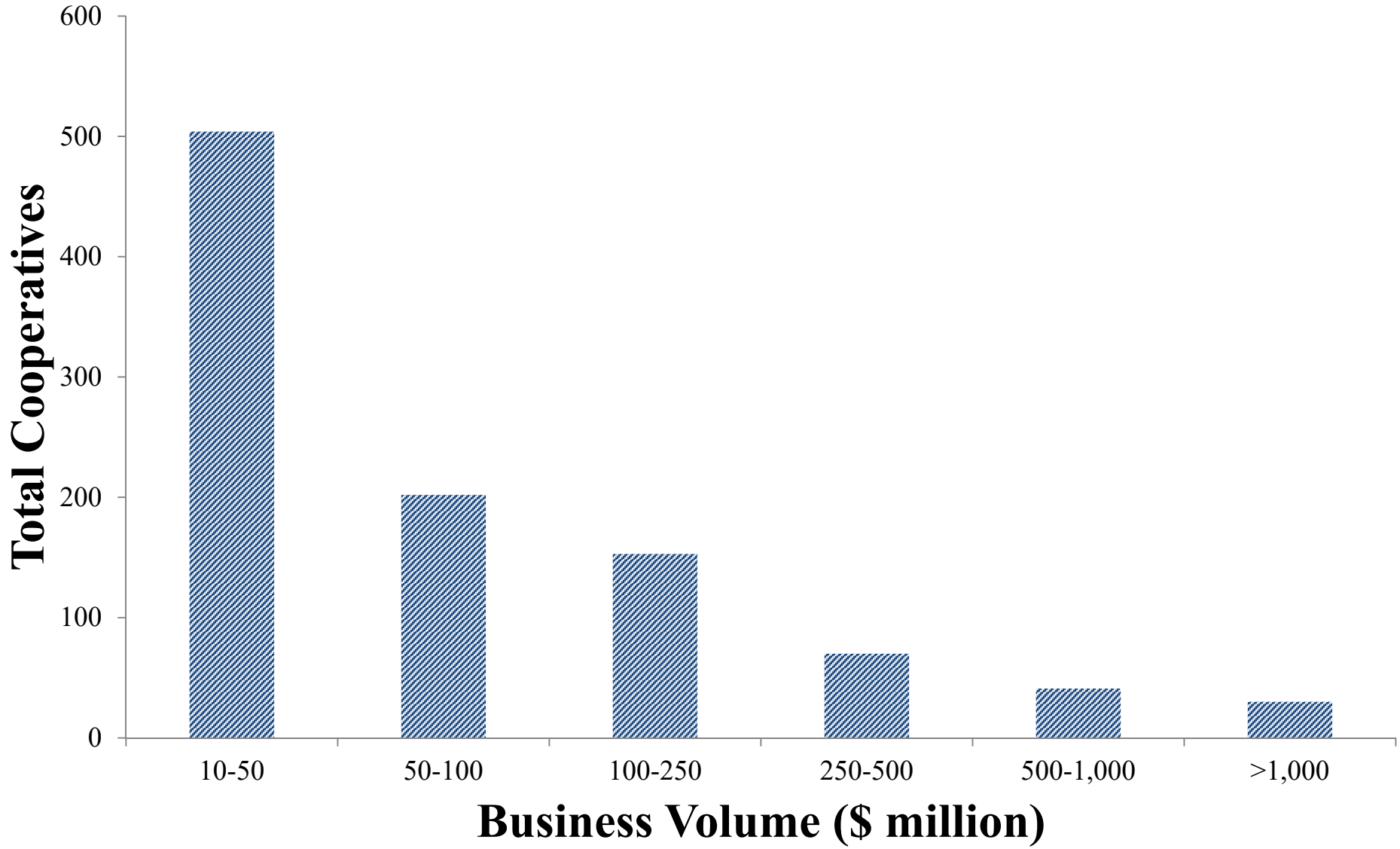
OBJECTIVES

1. Descriptive Analysis of Cooperative Performance
   - Summary Statistics
2. Empirical Analysis of Cooperative Performance
   - DuPont Method
   - Quantile Regression
3. Inform Recommendations for Improving Farmer Cooperative Performance

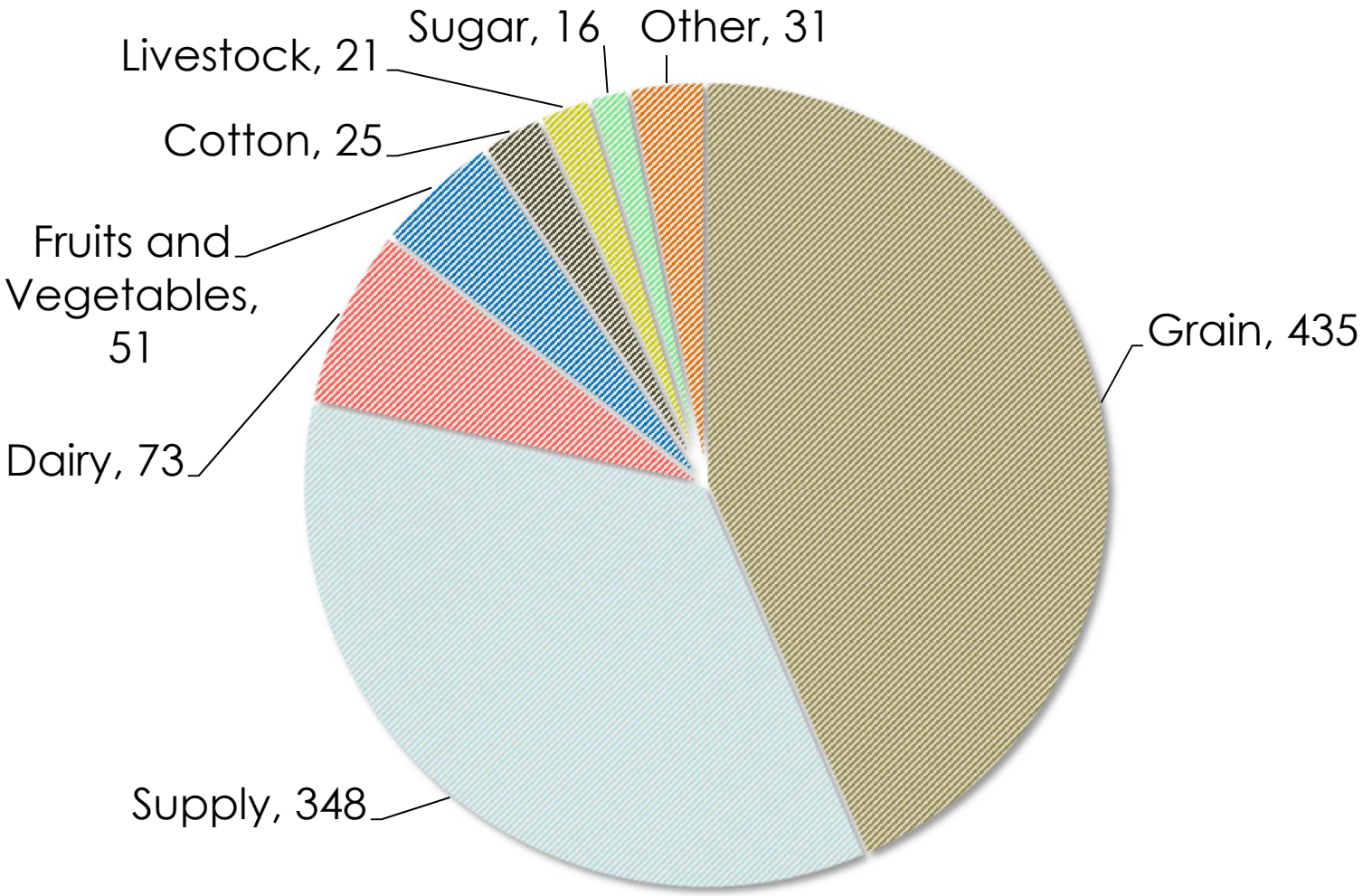
DATA

- USDA Data for Fiscal Year 2014
  - Balance Sheet (assets, liabilities, equity)
  - Income Statement (sales, costs, income)
  - Identity (size, location, function)
- 2,000 Economically Active Farmer Cooperatives
- Top 1,000 Comprise 98.4% of Business Volume

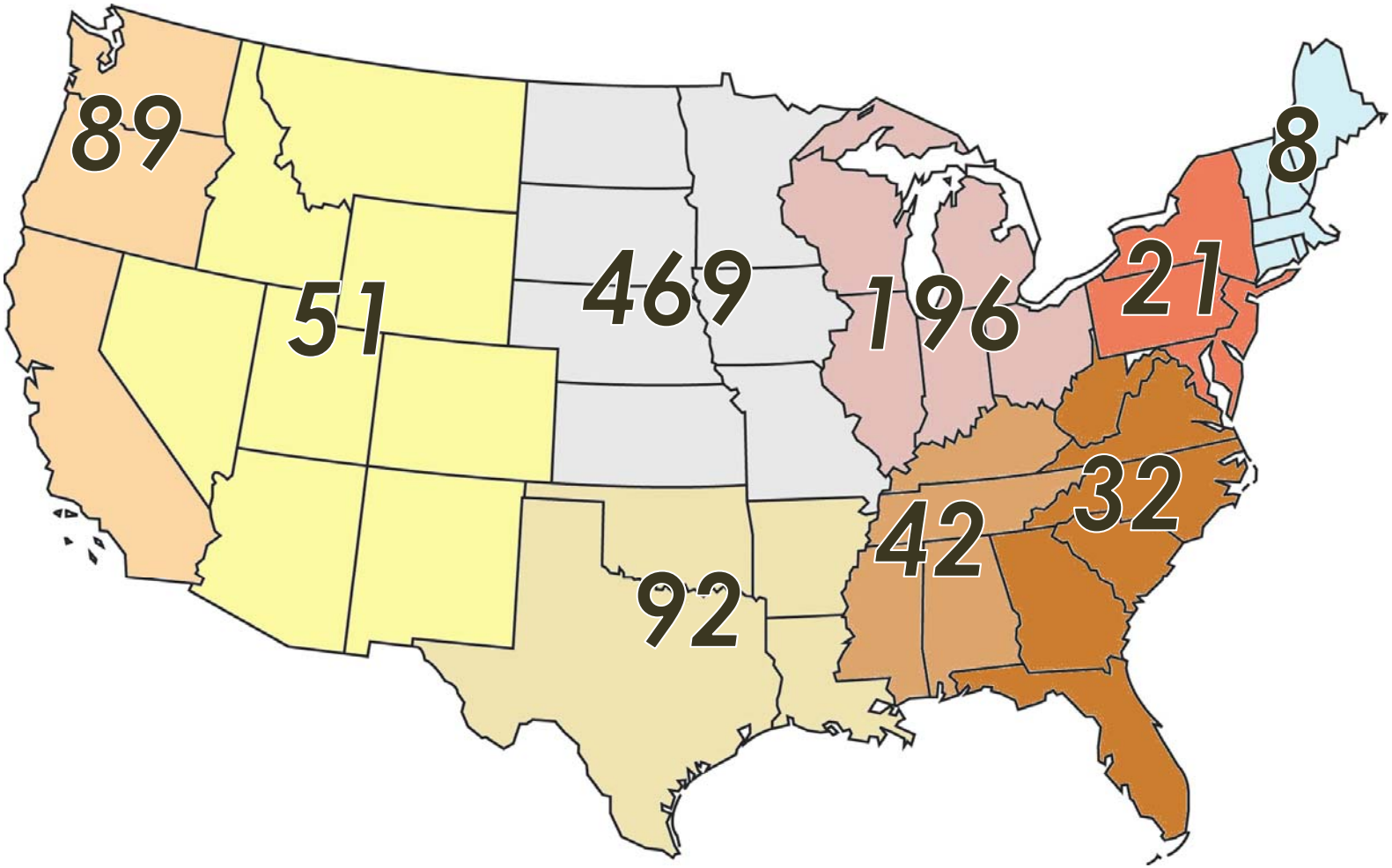
Heterogeneity in Size



Heterogeneity in Function



HETEROGENEITY IN GEOGRAPHY



Summary Statistics

Variable	Mean	S.D.	Quantiles 0.25	0.5	0.75
Total Assets (million)	84.84	554.75	9.37	20.35	48.42
Members (hundred)	16.29	78.177	2.37	5.41	12.59
Employees	153.32	550.48	18.75	40.00	102.25
Business Volume (million)	242.67	1,612.26	23.30	49.39	127.64
Net Income (million)	6.36	50.04	0.41	1.18	3.20
ROE	0.52	11.64	0.07	0.13	0.19
Tax Burden	0.92	0.22	0.86	0.94	1.00
Interest Burden	0.79	1.77	0.80	0.92	0.98
Operating Profit Margin	0.04	0.06	0.02	0.03	0.05
Asset Turnover	7.32	94.28	1.87	2.46	3.43
Leverage	4.31	33.02	1.59	2.00	2.72

DuPont Identity

- Return on Equity (ROE) = Tax Burden * Interest Burden * Operating Profit Margin * Asset Turnover * Leverage
  - Tax Burden Ratio = Net Income / EBT
  - Interest Burden Ratio = EBT / EBIT
  - Operating Profit Margin = EBIT / Total Sales
  - Asset Turnover Ratio = Total Sales / Total Assets
  - Leverage Ratio = Total Assets / Total Equity
- Few Empirical Applications (Fairfield and Yohn, 2001; Nissim and Penman, 2001; Soliman, 2008; Baum, 2014)

QUANTILE REGRESSION

- OLS (Mean) and Quantile (Median) Regression (Koenker, 2005; Santos-Silva, 2015)

$$y_i|x_i = \alpha + x_i'\beta$$

$$Q_\tau(y_i|x_i) = \alpha(\tau) + x_i'\beta(\tau)$$

- Two Advantages:
  1. Differential Impact Measurement across Response Distribution
  2. Immune to Outliers

Model Specification

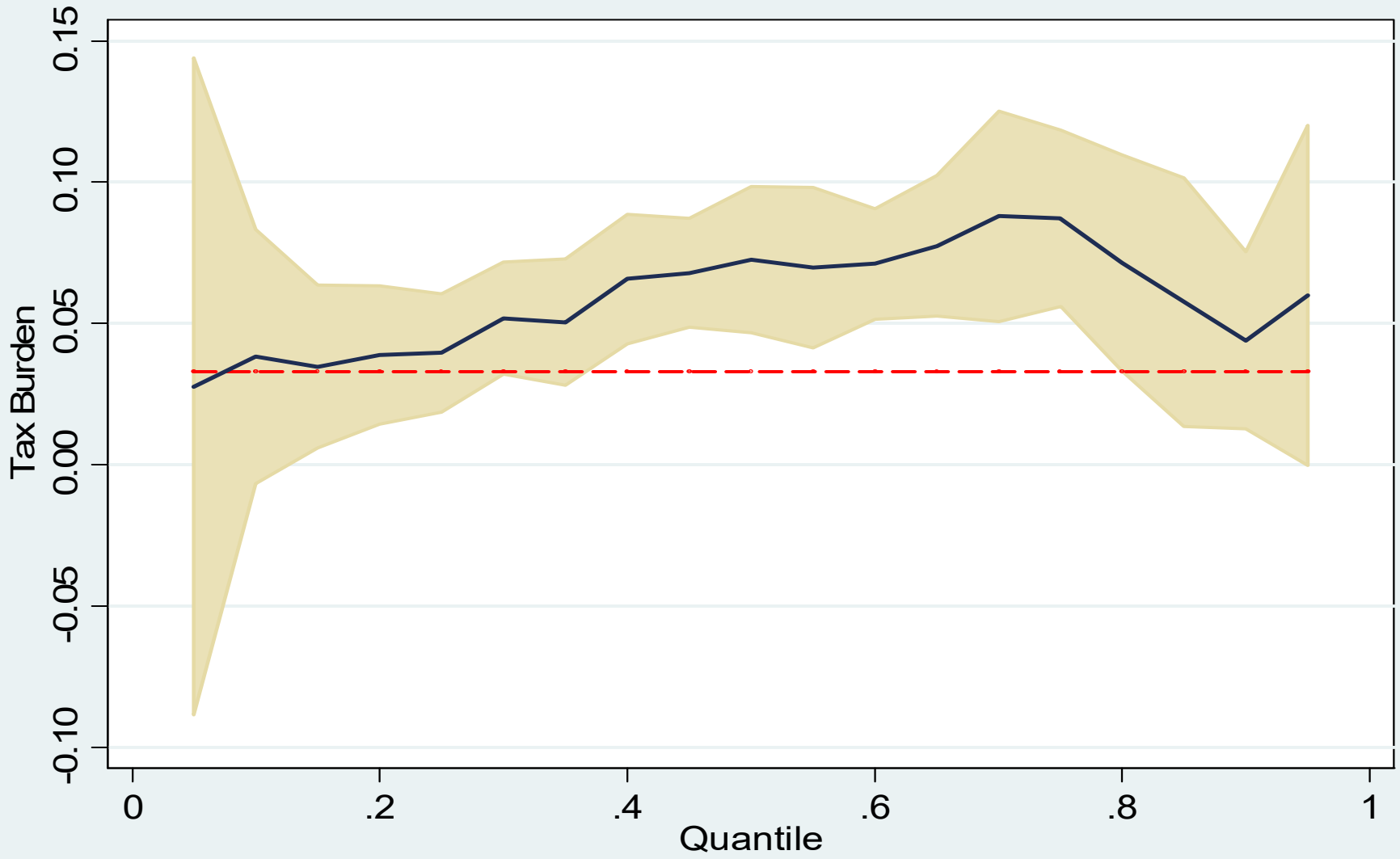
$$y = a + \rho_1(\textit{Tax Burden}) + \rho_2(\textit{Interest Burden}) + \rho_3(\textit{Operating Profit}) + \rho_4(\textit{Asset Turnover}) + \rho_5(\textit{Leverage}) + \psi_1 x_1 + \psi_2 x_2 + \psi_3 x_3 + \varepsilon$$

- y — ROE
- a — intercept
- x_1 — vector of region control variables
- x_2 — vector of commodity sector control variables
- x_3 — vector of organizational size control variables
- ρ, ψ — unknown parameters
- ε — heteroskedasticity-robust disturbance

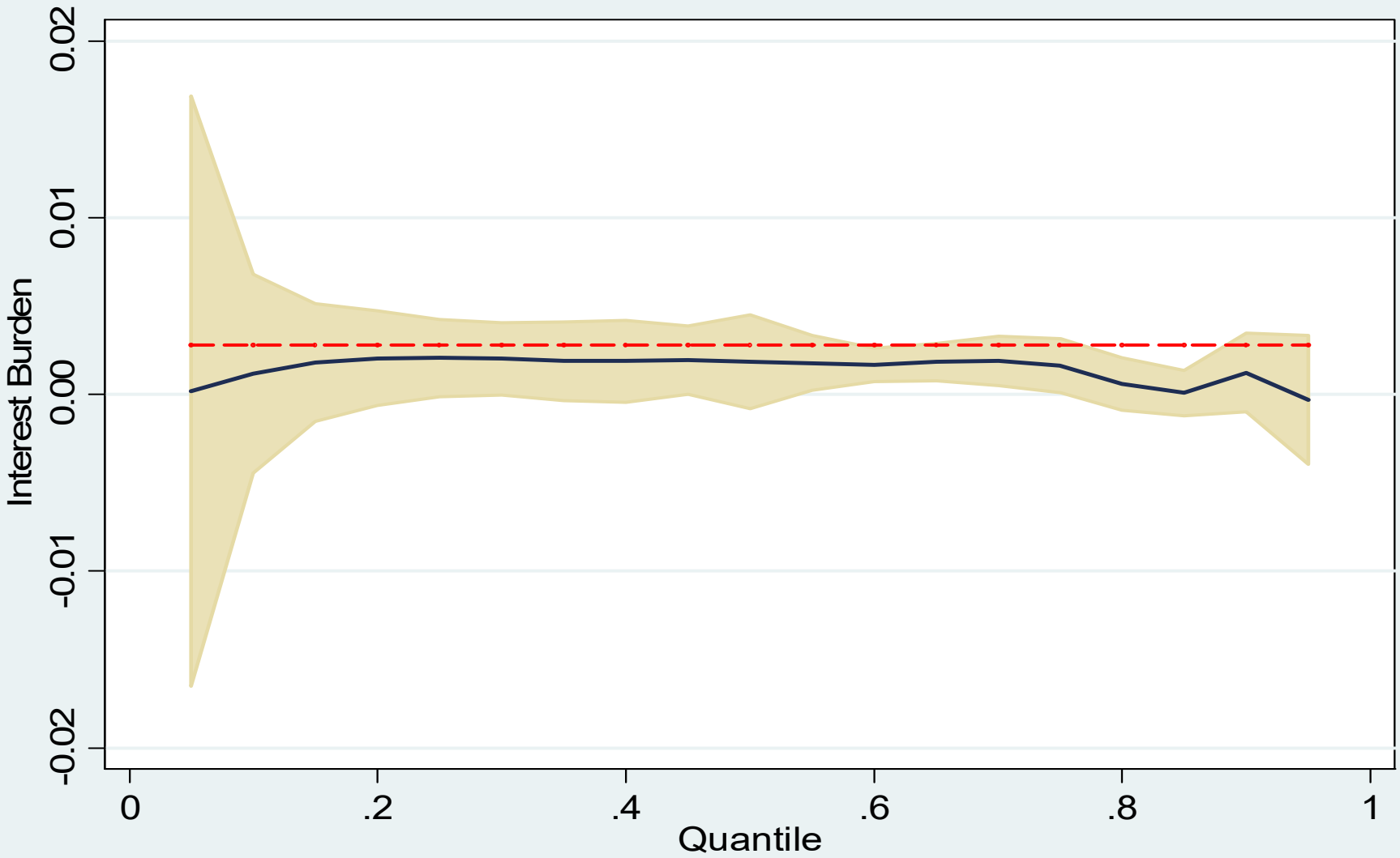
Results – Full Sample

Variable	Quantile 0.10	0.25	0.50	0.75	0.90
Intercept	-0.043	-0.021	-0.015	-0.050	0.037
	(0.067)	(0.037)	(0.05)	(0.078)	(0.033)
DuPont Components					
Tax Burden	0.038	0.040**	0.073***	0.087**	0.044***
	(0.036)	(0.017)	(0.021)	(0.041)	(0.009)
Interest Burden	0.001*	0.002	0.002***	0.002**	0.001
	(0.001)	(0.002)	(0.000)	(0.001)	(0.001)
Operating Profit	1.315***	1.762***	2.178***	2.680***	3.228***
	(0.415)	(0.151)	(0.160)	(0.290)	(0.363)
Asset Turnover	0.002***	0.002***	0.004***	0.015***	0.026***
	(0.001)	(0.000)	(0.001)	(0.005)	(0.003)
Leverage	0.000***	0.000**	0.000	0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)
Controls	Included	Included	Included	Included	Included
N	947	947	947	947	947
Pseudo R^2	0.27	0.30	0.31	0.23	0.15

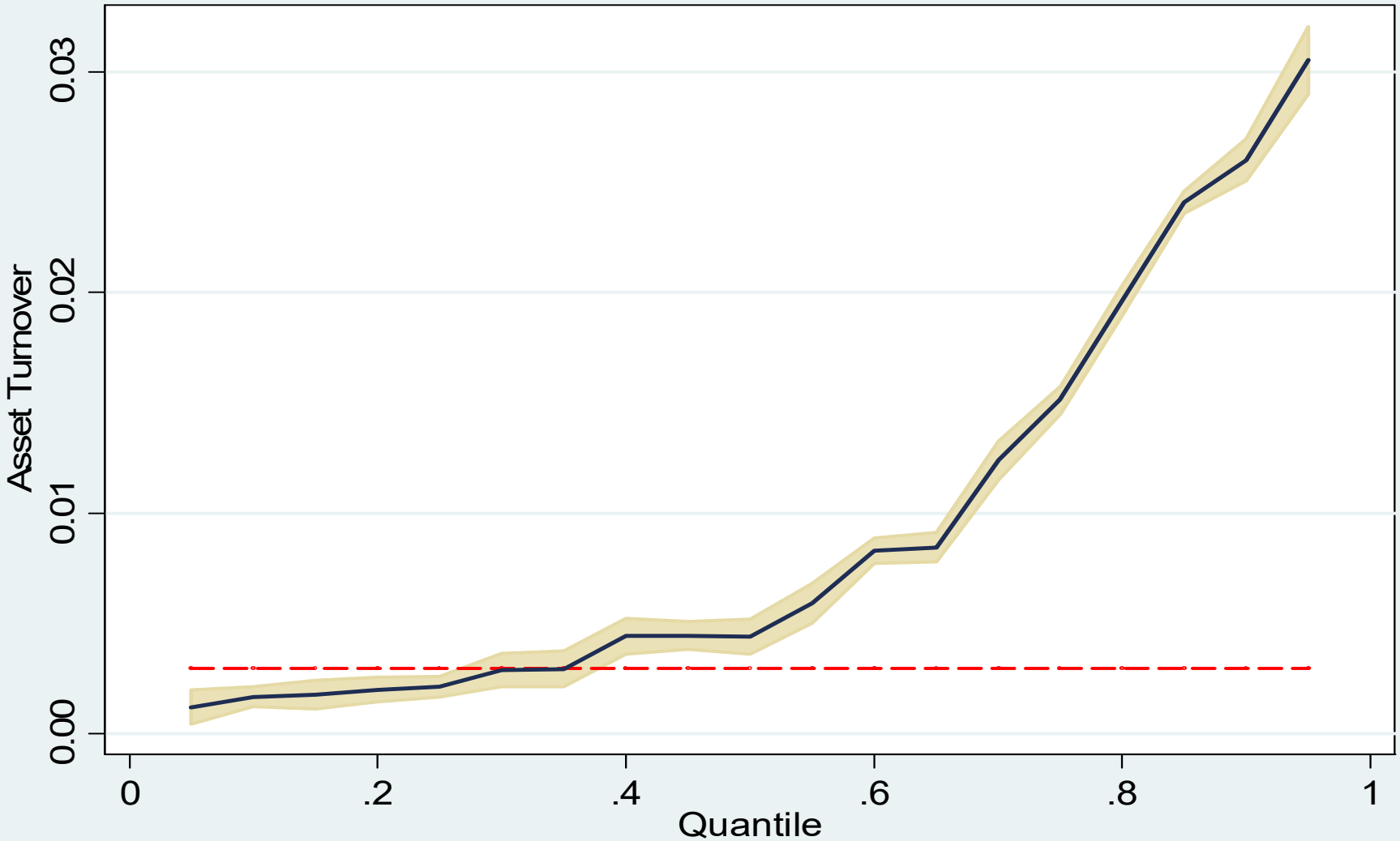
Tax Burden



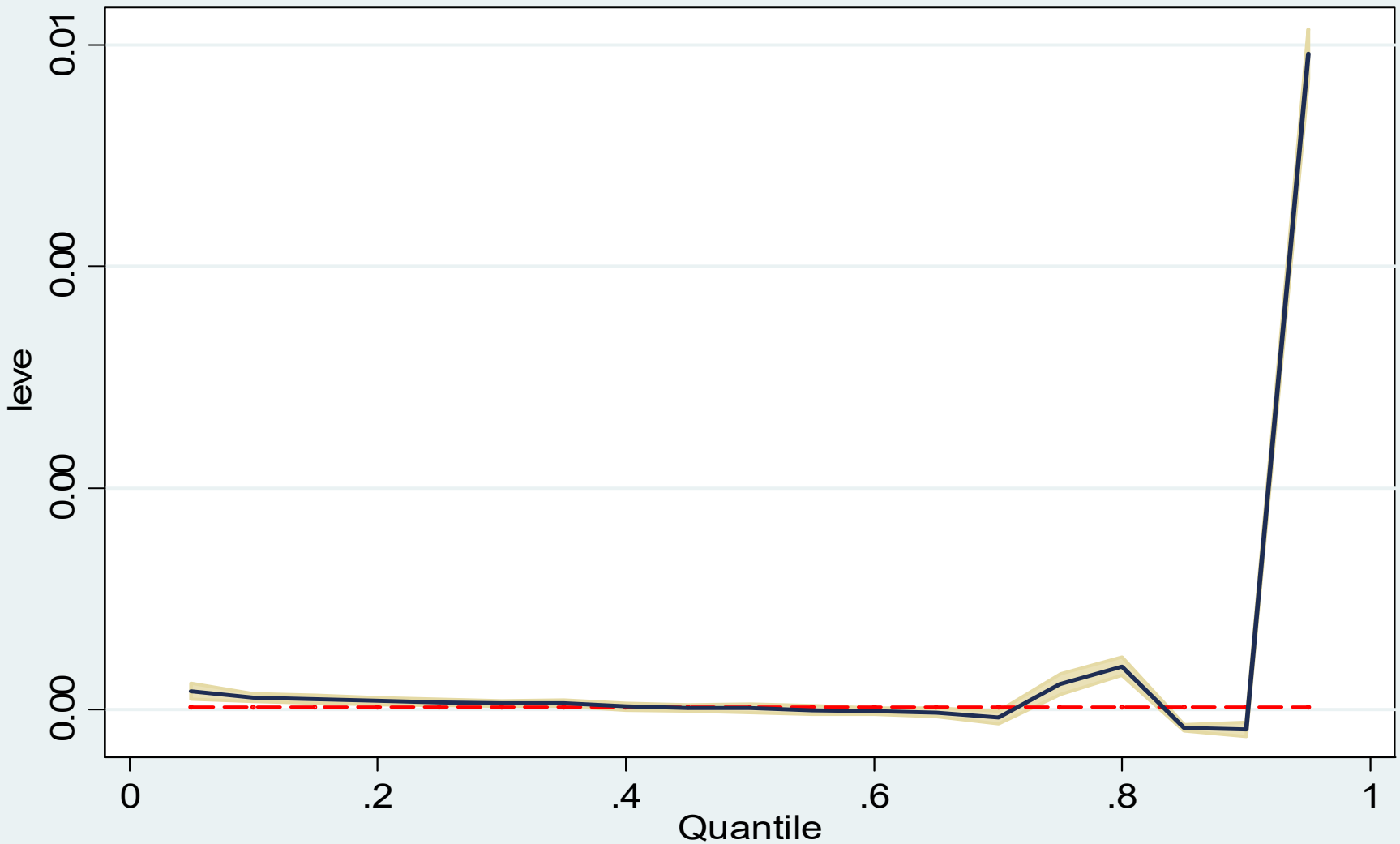
Interest Burden



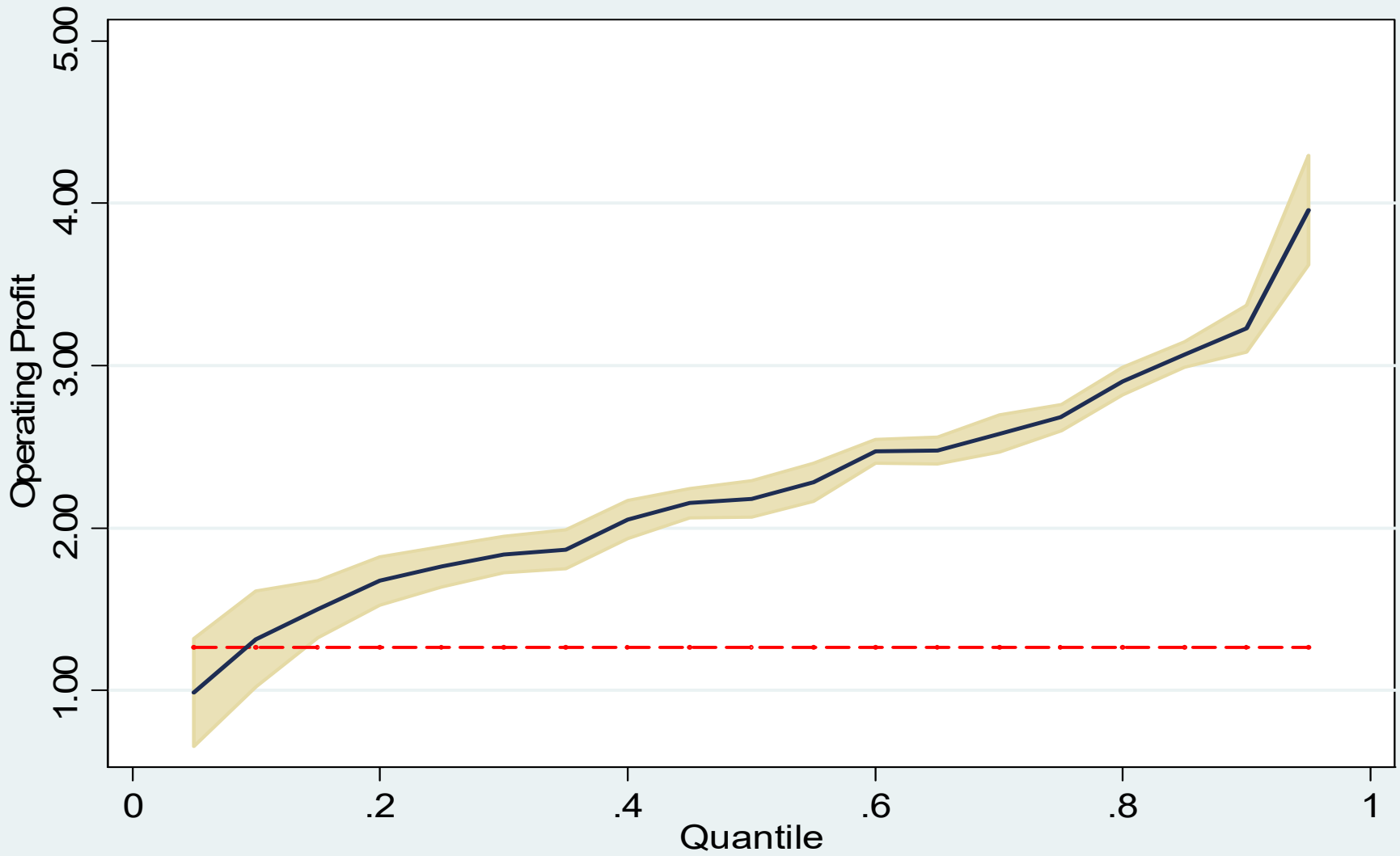
Asset Turnover



Leverage



Operating Profit



Results – Supply

Variable	Quantile 0.10	0.25	0.50	0.75	0.90
Intercept	-0.117**	-0.229***	-0.373***	-0.398***	-0.411***
	(0.058)	(0.077)	(0.090)	(0.068)	(0.046)
DuPont Components					
Tax Burden	0.081***	0.093***	0.117***	0.138***	0.106***
	(0.028)	(0.023)	(0.02)	(0.016)	(0.035)
Interest Burden	0.024*	0.068	0.104	0.055	0.049***
	(0.014)	(0.045)	(0.071)	(0.059)	(0.008)
Operating Profit	1.464***	1.916***	2.495***	2.925***	3.318***
	(0.368)	(0.310)	(0.207)	(0.182)	(0.142)
Asset Turnover	0.013	0.028***	0.048***	0.058***	0.060***
	(0.011)	(0.007)	(0.007)	(0.005)	(0.003)
Leverage	0.011**	0.026**	0.051***	0.060***	0.080***
	(0.005)	(0.010)	(0.011)	(0.010)	(0.018)
Controls	Included	Included	Included	Included	Included
N	348	348	348	348	348
Pseudo R^2	0.54	0.60	0.60	0.60	0.58

Results – Marketing

Variable	Quantile 0.10	0.25	0.50	0.75	0.90
Intercept	-0.060	-0.023	0.031	0.081	0.026
	(0.072)	(0.048)	(0.076)	(0.065)	(0.113)
DuPont Components					
Tax Burden	0.015	0.033	0.053	0.024	0.049*
	(0.026)	(0.021)	(0.042)	(0.020)	(0.027)
Interest Burden	0.000	0.002	0.003	0.002***	0.002
	(0.001)	(0.002)	(0.003)	(0.001)	(0.001)
Operating Profit	1.770***	2.062***	2.444***	2.777***	3.609***
	(0.658)	(0.377)	(0.326)	(0.363)	(1.170)
Asset Turnover	0.002**	0.002***	0.003***	0.012**	0.018*
	(0.001)	(0.001)	(0.001)	(0.006)	(0.011)
Leverage	0.000***	0.000*	0.000	0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Controls	Included	Included	Included	Included	Included
N	593	593	593	593	593
Pseudo R^2	0.27	0.26	0.26	0.21	0.16

Possible Recommendations

- Improve Bargaining Power (Valentinov, 2007)
  - Supply Control (Hovelaque et al., 2009; Merel et al., 2009)
- Pursue Product Differentiation (Grunert, 2005; Merel et al., 2009)
  - Partial or Separate Pooling (Liang and Hendrikse, 2016)
  - Supply Agreements with Quality Requirements
  - Vertical Interaction or Integration (Reynolds, 2012; Eversull, 2014)
- Grow Scale Economies
  - Consolidation (Briggeman et al., 2016)
  - Ownership Structure Adapation (Grashuis and Cook, 2016)

Summary and Conclusion

- Possible Contributions
  - Produced New Evidence of the Causal Nature of Financial Performance: Operating Profit Margin is Most Important
  - Informed Recommendations for Long-Term Viability: Bargaining Power, Product Differentiation, Scale Economies
- Future Research
  - Comparison to Agricultural Firms
  - Time-Series Analysis
  - Consideration of Full Population
  - Further Consideration of Purpose and Strategy

QUESTIONS?

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