Mergers and Acquisitions by U.S. Farmer Cooperatives: An Empirical Study of Capital Capacity, Spatial Competition, and Strategic Orientation

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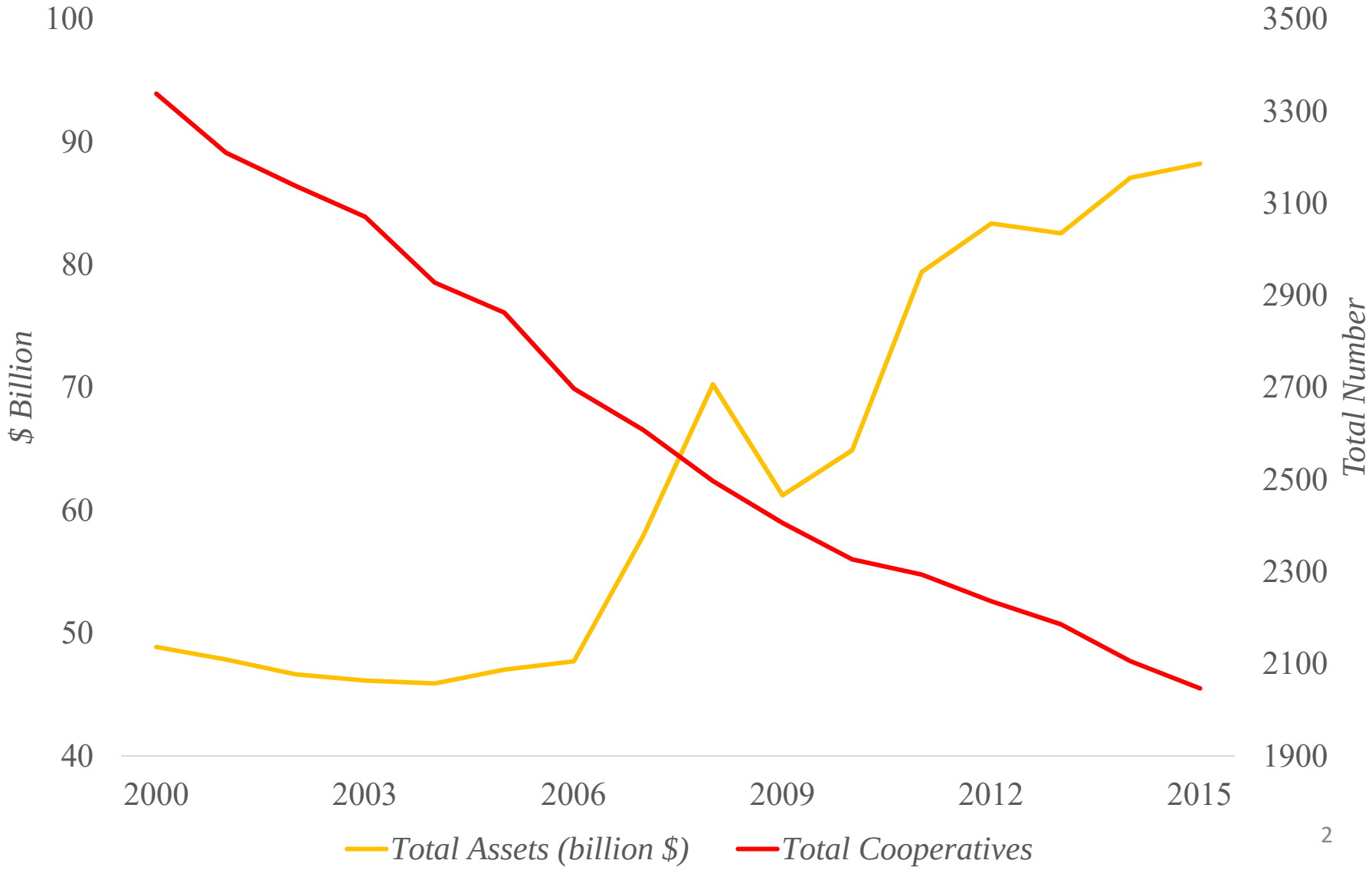
INTRODUCTION



INTRODUCTION

- 4,259 Exits from 1979–2014 (Eversull, 2014)
- 1,181 Exits from 2000–2013 (Eversull, 2014)
  - 48% merged, converted, acquired
- 2,106 in 2014 to 2,047 in 2015 (-2.8%) (USDA, 2017)

- Examples of recent M&As
  - South Dakota Wheat Growers and North Central Farmers Elevator (SD)
  - Central Valley Ag and Farmway (KS)
  - Cedar Country Cooperative, Lakeland Cooperative, and United Ag Cooperative (WI)

EMPIRICAL LITERATURE ON M&AS

- Hudson and Herndon (2002)
  - 74 observations (cross-section of U.S. cooperatives)
- Richards and Manfredo (2003)
  - 1,308 observations, 19 years (panel of U.S. cooperatives)
- Melia-Marti and Martinez-Garcia (2015)
  - 147 observations (cross-section of Spanish cooperatives)

MAIN FINDINGS

- Hudson and Herndon (2002)
  - negative relationship of cash patronage obligations (-0.005) to the probability of engaging in future strategic transactions
- Richards and Manfredo (2003)
  - negative impact of the current ratio (-0.431) and the debt ratio (-1.306) on the likelihood of merger activity
- Melia-Marti and Martinez-Garcia (2015)
  - probability of acting as the target (as opposed to the bidder) increased in the quick ratio (8.3%) and decreased in ROA (-8.4%)

RESEARCH QUESTION

What are the financial, competitive, and strategic characteristics of U.S. farmer cooperatives which engaged in mergers and acquisitions from 2014 to 2016?

HYPOTHESES

- Capital Capacity
  - Current Ratio (+) (Richards and Manfredo, 2003)
  - Debt Ratio (-) (Richards and Manfredo, 2003)
  - ROA (-) (Melia-Marti and Martinez-Garcia, 2015)
- Spatial Competition
  - Market Share (-) Huyghebaert and Luypaert (2010)
  - Distance (+) Weterings and Marsili (2015)
- Strategic Orientation
  - Brand or Product Differentiation (-) Desyllas and Hughes (2009)

DATA

Variable	Description	Mean	Median	Source
Y (M&A Activity and Frequency)				
Activity	1 if the cooperative completed one or more M&As in the 2014-2016 period	0.07	0.00	Various
Frequency	number of completed M&As in the 2014-2016 period	0.09	0.00	Various
X_1 (Capital Capacity)				
Sales ($M)	total sales	244.85	49.69	USDA
ROA	net income / total assets	0.20	0.06	USDA
Current Ratio	current assets / current liabilities	1.79	1.42	USDA
Debt Ratio	total liabilities / total assets	0.51	0.50	USDA

DATA

Variable	Description	Mean	Median	Source
X_2 (Spatial Competition)				
Market Share	business volume / business volume of all cooperatives in the same commodity sector	0.06	0.00	USDA
Distance	geodesic distance to the nearest cooperative in the same commodity sector	45.89	21.82	
X_3 (Strategic Orientation)				
Product Differentiation	number of live trademarks owned at the end of 2014	1.77	0.00	USPTO
z (Control Variables)				
Census Region	New England; Middle Atlantic; South Atlantic; West South Central; East South Central; West North Central; East North Central; Mountain; Pacific			U.S. Census

METHODOLOGY

- Probit
- Negative Binomial
- Bayesian Additive Regression Trees

EMPIRICAL MODEL – PROBIT

$$pr(y_i = 1|x_i) = f(\beta' x_i) \quad (1)$$

$$pr(y_i = 1|x_i) = \alpha + \vartheta_1 x_1 + \vartheta_2 x_2 + \vartheta_3 x_3 + \varphi z_i + \varepsilon_i \quad (2)$$

- y = M&A Activity (binary variable)
- x_1 = Capital Capacity
- x_2 = Spatial Competition
- x_3 = Strategic Orientation
- z = Control Variables (U.S. Census regions)

EMPIRICAL MODEL – NEGATIVE BINOMIAL

$$pr\left(Y_{ij} = y_{ij} \middle| x_{ij}\right) = \frac{e^{-\lambda_{ij}u_{ij}}\left(\lambda_{ij}u_{ij}\right)^{y_{ij}}}{y_{ij}!}, y_{ij} = 0, 1, 2, \ldots \quad (1)$$

$$\tilde{\lambda}_i = \alpha + \vartheta_1 x_1 + \vartheta_2 x_2 + \vartheta_3 x_3 + \varphi z_i + \varepsilon_i \quad (2)$$

- y = M&A Activity (count variable)
- x_1 = Capital Capacity
- x_2 = Spatial Competition
- x_3 = Strategic Orientation
- z = Control Variables (U.S. Census regions)

RESULTS – PROBIT

Variable	Model 1	Model 2	Model 3
ln Sales	0.070*** (0.009)	0.067*** (0.008)	0.060*** (0.008)
ROA	-0.183* (0.097)	-0.211** (0.098)	-0.190* (0.103)
Current Ratio	-0.004 (0.004)	-0.004 (0.004)	-0.004 (0.004)
Debt Ratio	-0.147*** (0.050)	-0.144*** (0.049)	-0.147*** (0.049)
Local Share	-0.130*** (0.044)		
Regional Share		-0.226*** (0.073)	
Distance			0.099** (0.041)
ln Trademark Ownership	-0.021** (0.011)	-0.019* (0.010)	-0.025** (0.010)
N	983	983	983
Wald Chi2	600.84	857.87	418.42
Prob > Chi2	0.000	0.000	0.000
McFadden R^2	0.20	0.20	0.20
% Correctly Classified	92.47%	92.68%	92.68%

Results – Negative Binomial

Variable	Model 1	Model 2	Model 3
ln Sales	4.33*** (0.760)	4.733*** (0.797)	3.895*** (0.557)
ROA	0.045 (0.089)	0.044 (0.086)	0.037 (0.077)
Current Ratio	0.896 (0.132)	0.943 (0.089)	0.910 (0.119)
Debt Ratio	0.033*** (0.037)	0.063** (0.068)	0.042*** (0.045)
Local Share	0.399 (0.287)		
Regional Share		0.026*** (0.031)	
Distance			2.827 (2.207)
ln Trademark Ownership	0.614*** (0.110)	0.702** (0.118)	0.620*** (0.108)
N	983	983	983
Wald Chi2	6433.100	4219.857	2817.810
Prob > Chi2	0.000	0.000	0.000
McFadden R^2	0.25	0.26	0.25
Cragg-Uhler R^2	0.29	0.30	0.29

SDSU Extension

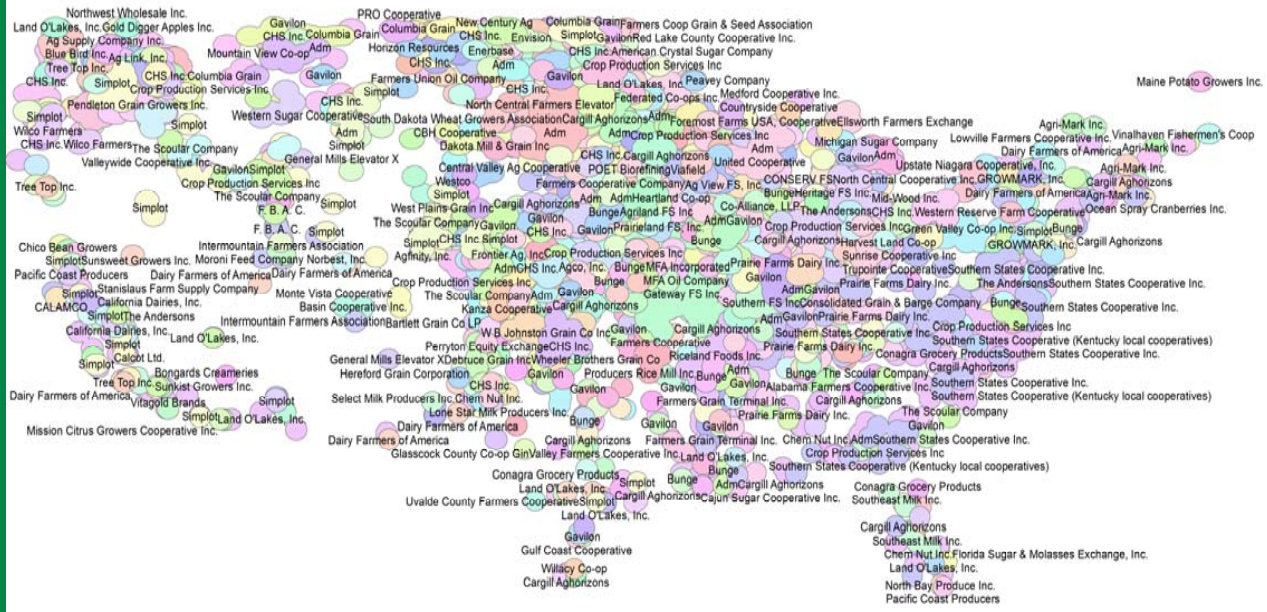
Scrape Yellowpages.com

- 30 mile trade areas
  - Establishments

Examine competition

Trade area characteristics

Trade area, MNC Competition, and Merger activity

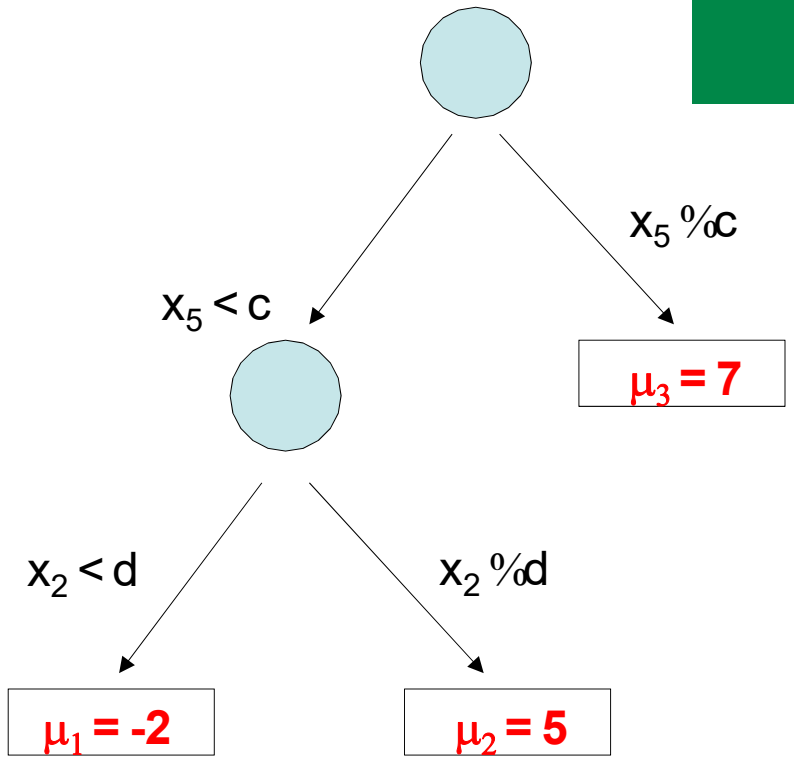


iGrow.org

Alternative method: Decision Tree Mod

Let $M = \{\mu_1, \mu_2, \ldots, \mu_b\}$ denote the set of bottom node μ's.

Let $g(x;\theta)$, $\theta = (T, M)$ be a regression tree function that assigns a μ value to x.



A single tree model:

$$y = g(x;\theta) + E.$$

Bayesian Additive Regression Trees: BART

- Some Distinguishing Feastures of BART:
- BART is NOT Bayesian model averaging

of single tree model. Unlike Boosting and

Random Forests, BART updates a set of *m*

- trees over and over, *stochastic search*.
- Choose *m* large for flexible

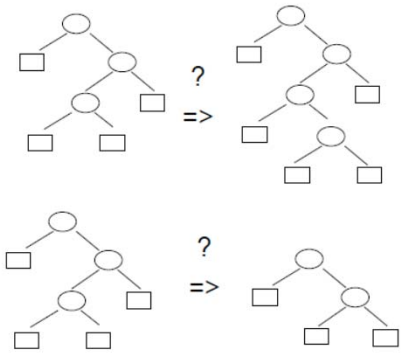
estimation and prediction.

Choose *m* smaller for variable

selection

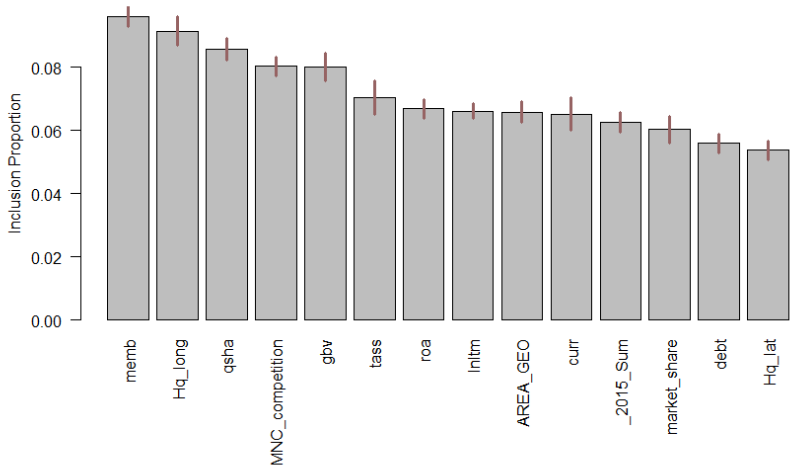
- - fewer trees forces the *x* 's to compete for entry.

Non-Linearity and Interaction Effects

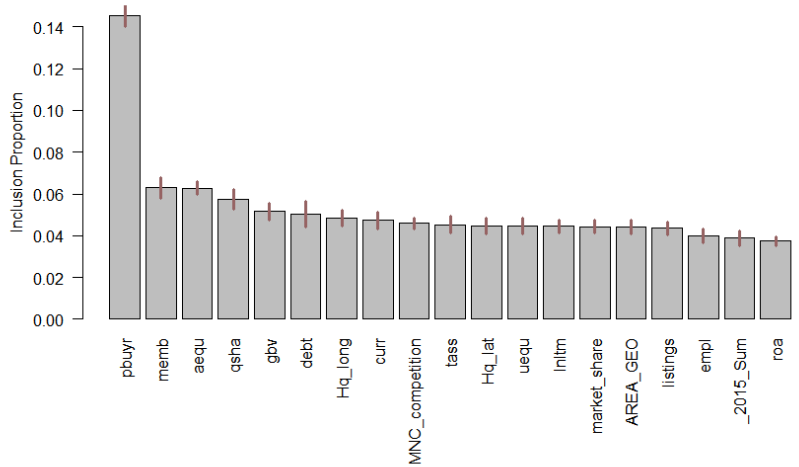


BART Variable Importance

With out previous merger activity

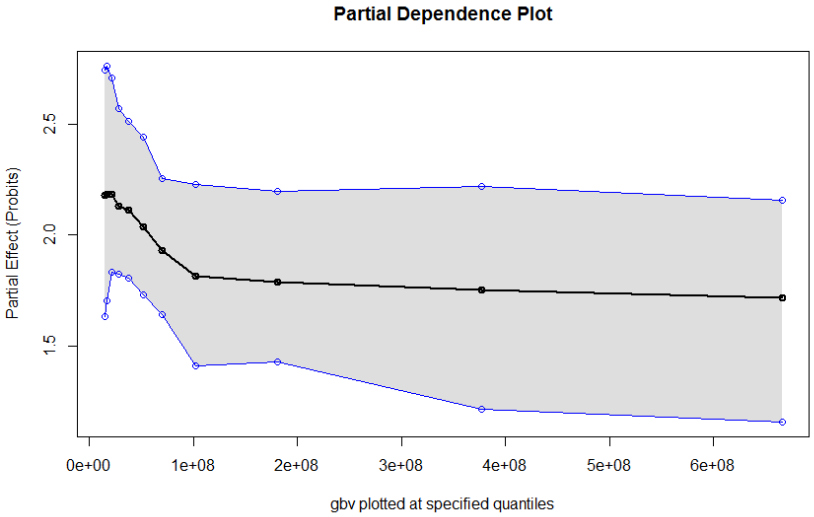


With previous merger activity

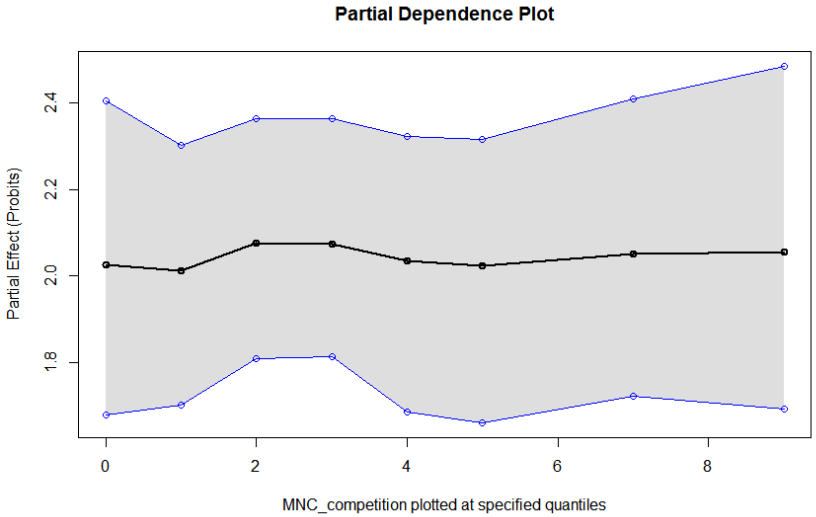


BART Partial Dependence Plots

Gross Business Volume

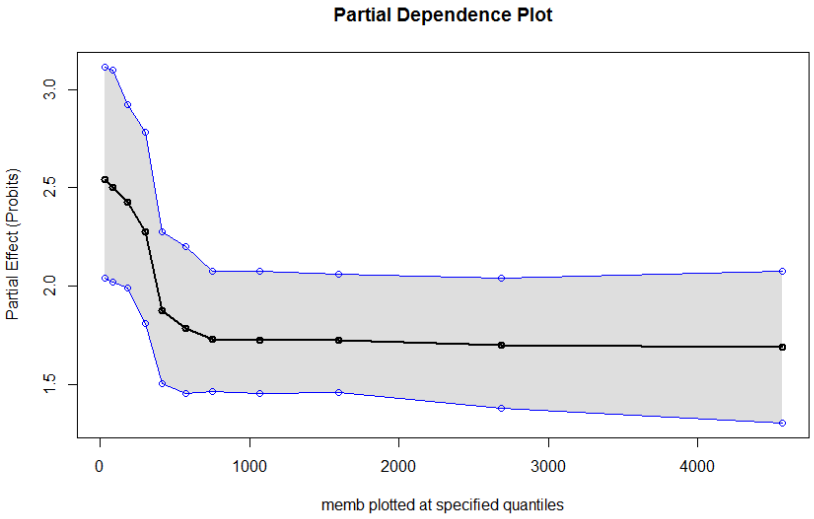


Multi-National Competition

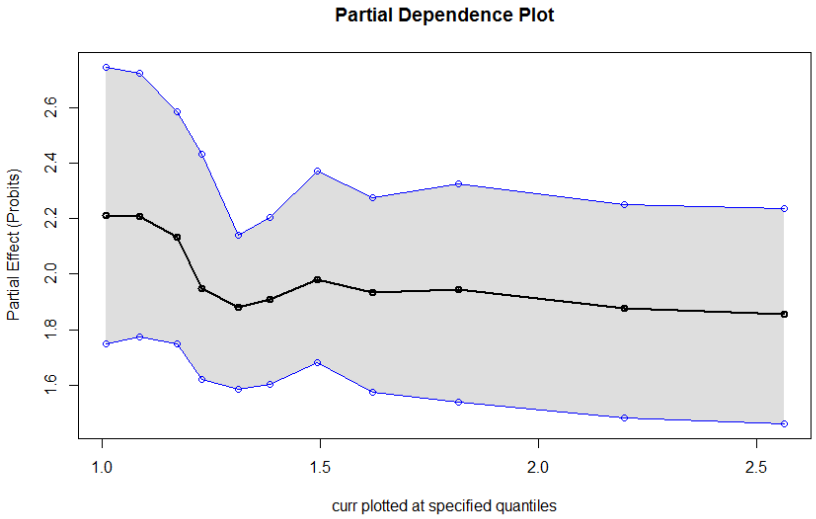


BART Partial Dependence Plots

Membership

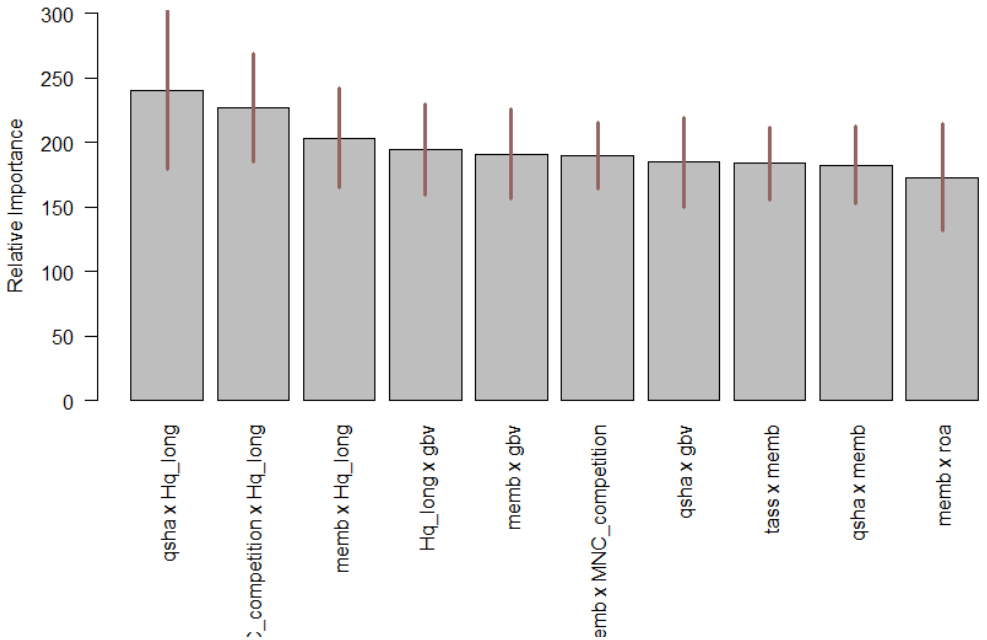


Current Ratio



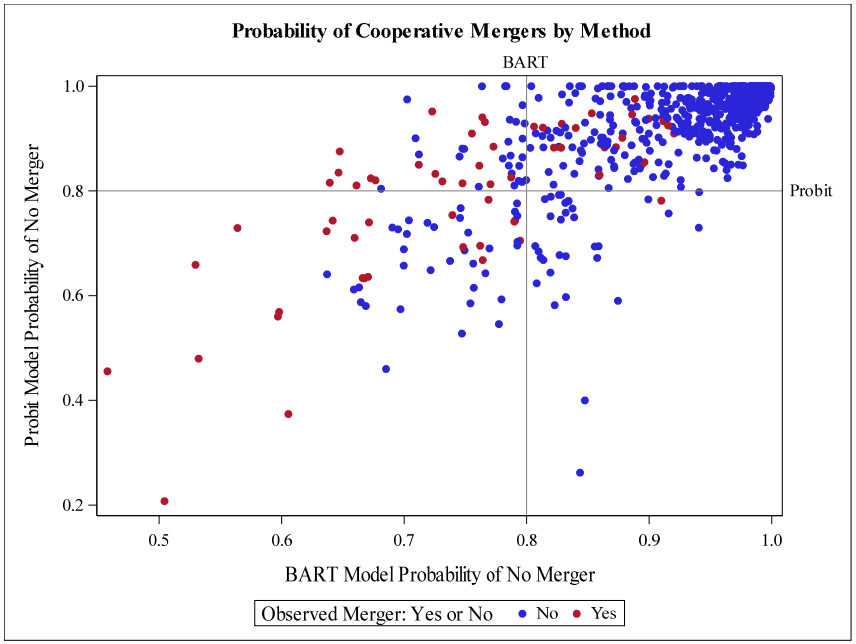
Interaction Effects

Without Previous Mergers



BART Prediction Accuracy

Without Previous Mergers



BART correctly, predicted 17 more in sample mergers while reducing 5 false predictions compared to the probit

Conclusions

- Recent Merger activity is mostly explained by size
- allocated equity, central region, and strategy are important
- Machine learning techniques can enhance merger prediction accuracy, particularly when there is not a strong signal
- BART can provide machine learning prediction accuracy with statistical inferences-- comparable to probit and logit models.