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An Analysis of Financial Risk Measures within Agricultural Cooperatives

Kristi Schweiss

NCERA210 Presentation

Literature Review

- Gabriel & Baker (1980) “Concepts of Business and Financial Risk”
- Barry (1984) “Risk Management in Agriculture”
- Collins (1985) “Expected Utility, Debt-Equity Structure, and Risk Balancing”
- Barton, Parcell & Featherstone (1996) “Optimal Capital Structure in Centralized Agricultural Cooperatives”
- Cheng & Gloy (2008) “The Paradox of Risk Balancing: Do Risk-Reducing Policies lead to more risk for Farmers”

Introduction

Business Risk

- Production & Technical
- Market & Price
- Institutional (Legal & Social)
- Human
- Technological

Financial Risk

- Debt Financing

Measuring BR & FR

Business Risk Measures

- CoV of ROA (Barry, 1984)
- Variance of ROA (Collins, 1985)
- St. Dev of ROA (Lerman & Parliament, 1993)
- Variance of ROA (Barry, 2001)

Financial Risk Measures

- $TR(\text{CoV ROE})/BR$ (Barry, 1984)
- Variance of ROE (Collins, 1985)
- $TR(\text{St.Dev of ROE}) - BR$ (Lerman & Parliament, 1993)
- “May substantially influence the variability of returns on equity and the stability of farm equity” (Barry, 2001)

Measuring Financial Performance

- Lerman & Parliament (1991) “Size and Industry Effects in the Performance of Agricultural Cooperatives”
- Messina, et al. (1994) “Financial Ratio Analysis of Agricultural Cooperatives”

Research Question

- Do commonly used financial performance measures capture the effects of financial risk on cooperative performance?
 - Does the academic literature and lenders do an equal job at measuring financial risk?

Category						
Academic Literature	Debt Service Coverage*	Current Ratio*	Total Asset Turnover	Return on Equity	Return on Assets	Debt to Equity
Lender	Debt Service Coverage*	Current Ratio*	Working Capital to Total Sales	Long-Term Debt to Equity	Interest Coverage Ratio	Local Return on Sales

The Model

- Pro forma financial statements
- Stochastic Variables for Business Risk & Financial Risk
 - Business Risk – Sales Volume, Price and Margins
 - Financial Risk – Base Interest Rates, Credit Score and Bad Debts (Counterparty Risk)
- Base Case vs. Severe Case

Equation

- Net Income is our definition of total risk

$$(1) \pi = (P * Q) - TC$$

- $(4) \pi = \left[\left(F(P_{it}) * F(Q_{it}) \right) + OI_t \right] - \left[(VC''_{it} + FC_t + F(I_{it}) + F(BD_t)) \right]$

π = profit, $F(x)$ = stochastic variable, P = price, i = enterprise, t = time, Q = quantity, OI = other income, VC = variable cost, FC = fixed cost, TC = total cost, I = interest expense, and BD = bad debt

Business Risk Assumptions

Category	Distribution	Min, Most Likely, Max
Sales Volume		%
Grain	Triangular	(-0.4,0,0.4)
Fertilizer	Triangular	(-0.3,0,0.3)
Agronomy	Triangular	(-0.25,0,0.25)
Petroleum	Triangular	(-0.1,0,0.1)
Misc. Income	Triangular	(-0.1,0,0.1)
Price		\$
Grain	Triangular	(0.05,0.25,0.55)
Fertilizer	Triangular	(30,50,75)
Agronomy	Triangular	(0.05,0.15,0.25)
Petroleum	Triangular	(0.15,0.35,0.55)
Misc. Income	Triangular	-
Cost of Goods		\$
Grain	Triangular	(-0.5,0,0.5)
Fertilizer	Triangular	(-50,0,50)
Agronomy	Triangular	(-0.15,0,0.15)
Petroleum	Triangular	(-0.2,0,0.2)
Misc. Income	Triangular	-

Interest Rate Assumptions

Type of Interest	Scenario	Distribution	Min, Most Likely, Max
Revolving Credit	Base	Triangular	(0.03,0.04,0.05)
Revolving Credit	Severe	Triangular	(0.03,0.08,0.13)
Long Term Debt	Base	Triangular	(0.03,0.04,0.05)
Long Term Debt	Severe	Triangular	(0.03,0.08,0.13)

- Co-ops have been found to use variable interest rates for about 80% of their long term debt (CoBank, 2017)
 - Payments can change significantly

Credit Rating Assumptions

Ratio	Criteria	Score
$\frac{\text{Local Savings}}{\text{Total Sales}}$	> 2%	0
$\frac{\text{Term Debt}}{\text{Net Fixed Assets}}$	≤ 0.5	0
$\frac{\text{Working Capital}}{\text{Total Sales}}$	> 4%	0
$\frac{\text{Total LT Debt}}{\text{(Total Members' Equity – Regional Investment)}}$	≤ 50%	0
<i>Debt Service Coverage Ratio</i>	> 2	0
$\frac{\text{Local Savings} + \text{Interest Expense}}{\text{Interest Expense}}$	≥ 3	0
$\frac{\text{Current Assets}}{\text{Current Liabilities}}$	≤ 1.5	0

Score	1	2	3	4	5	6	7
	+ 0%	+ 0.50%	+ 0.75%	+ 1.00%	+ 1.50%	+ 2.50%	+ 4.00%

Bad Debt Expense Assumptions

Type	Scenario	Distribution	Min, Most Likely, Max
AR over 90 days	Base	-	1%
AR over 90 days	Severe	-	3%
Bad Debt Expense	Base	Triangular	(0.01,0.02,0.03)
Bad Debt Expense	Severe	Triangular	(0.05,0.10,0.15)

Results

- Coefficients of Variation
 - Academic Literature
 - Lender
- Contributions to Variation
 - Academic Literature ONLY
 - Total Asset Turnover not included because no financial risk contributed
 - Literature and Lender
 - Lender ONLY

Category						
Academic Literature	Debt Service Coverage*	Current Ratio*	Total Asset Turnover	Return on Equity	Return on Assets	Debt to Equity
Lender	Debt Service Coverage*	Current Ratio*	Working Capital to Total Sales	Long-Term Debt to Equity	Interest Coverage Ratio	Local Return on Sales

Literature Ratio CoVs

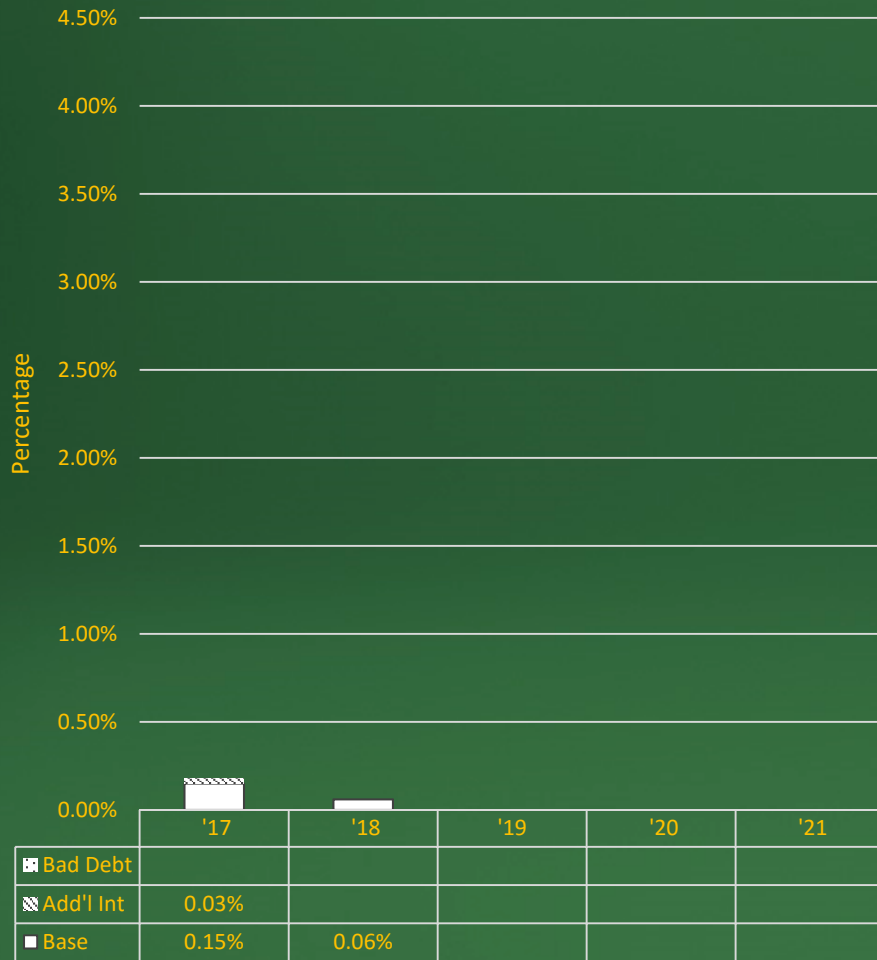
BASE CASE					
Variable	2017	2018	2019	2020	2021
Net Income	0.4620	0.5401	0.7120	0.8513	1.2250
ROE	0.4404	0.5161	0.6861	0.8260	1.2410
ROA	0.4595	0.5295	0.6898	0.8217	1.2118
ROE – ROA	0.4280	0.5079	0.6864	0.8338	1.2714
TAT	0.0071	0.0595	0.0831	0.1012	0.1165
DSC*	0.2436	0.2710	0.3026	0.3336	0.3761
CR*	0.0192	0.0285	0.0401	0.0511	0.0703
D/E	0.0333	0.0808	0.1039	0.1226	0.1420
SEVERE CASE					
Net Income	0.7259	0.8795	1.4732	1.7484	5.0002
ROE	0.7140	0.8732	1.5491	1.9232	11.2377
ROA	0.7241	0.8723	1.4817	1.7889	6.3925
ROE - ROA	0.7082	0.8752	1.5977	2.0214	19.0668
TAT	0.0069	0.0570	0.0795	0.0968	0.1114
DSC*	0.2857	0.3045	0.3271	0.3521	0.3942
CR*	0.0206	0.0309	0.0466	0.0619	0.0872
D/E	0.0417	0.0909	0.1237	0.1559	0.2109

Lender Ratio CoVs

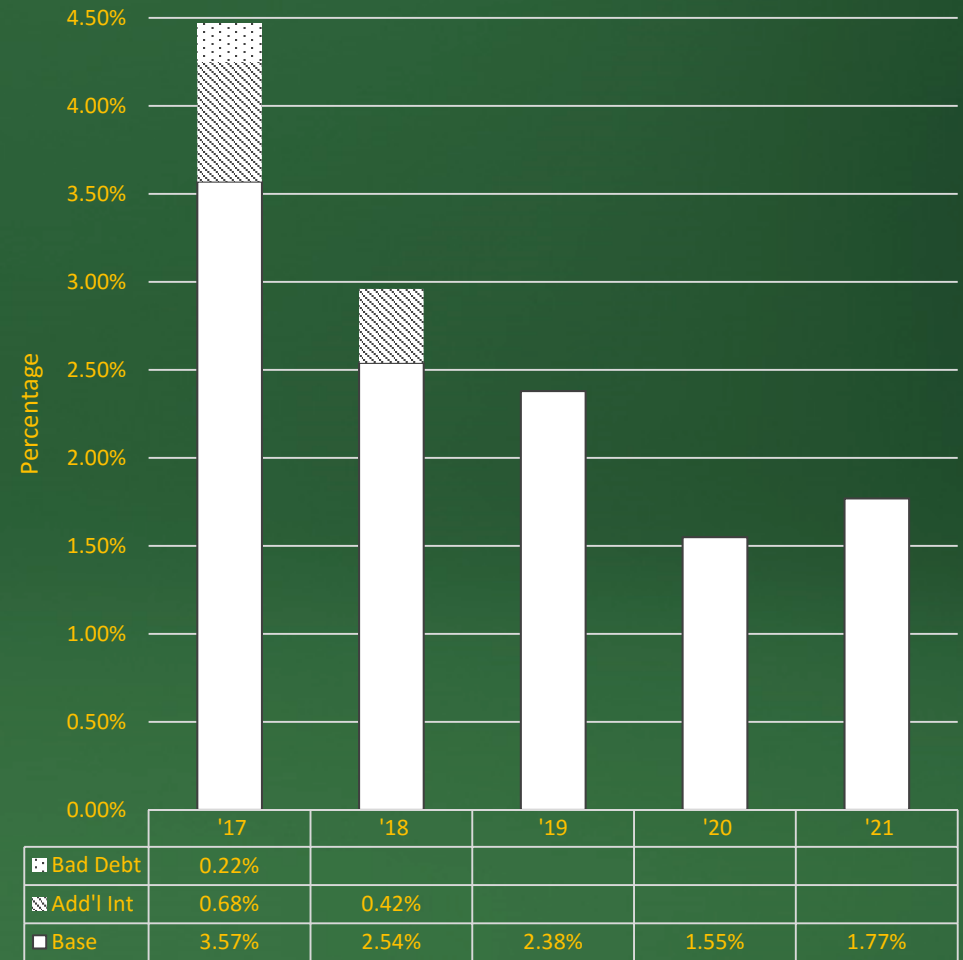
BASE CASE					
Variable	2017	2018	2019	2020	2021
Net Income	0.4620	0.5401	0.7120	0.8513	1.2250
DSC*	0.2436	0.2710	0.3026	0.3336	0.3761
CR*	0.0192	0.0285	0.0401	0.0511	0.0703
WC/S	0.1897	0.3302	0.2273	0.5000	0.6811
ICR	0.3803	0.4449	0.5365	0.6602	0.8517
LROS	0.4511	0.5016	0.6555	0.7909	1.2349
LTD/E	0.0266	0.0401	0.0542	0.0747	0.1030
SEVERE CASE					
Net Income	0.7259	0.8795	1.4732	1.7484	5.0002
DSC*	0.2857	0.3045	0.3271	0.3521	0.3942
CR*	0.0206	0.0309	0.0466	0.0619	0.0872
WC/S	0.2486	0.5626	0.4149	2.2767	61.7829
ICR	0.4662	0.5204	0.6164	0.7497	0.9782
LROS	0.7188	0.8569	1.5236	1.9187	12.0944
LTD/E	0.0396	0.0593	0.0831	0.1162	0.1730

Return on Equity

Base Case

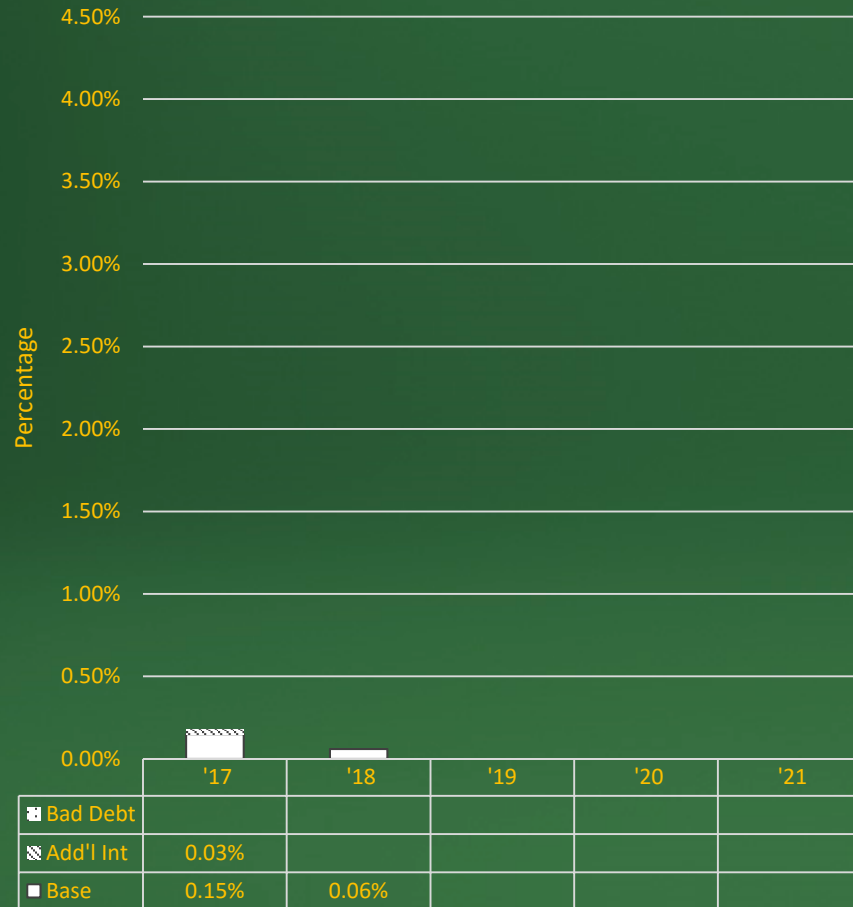


Severe Case

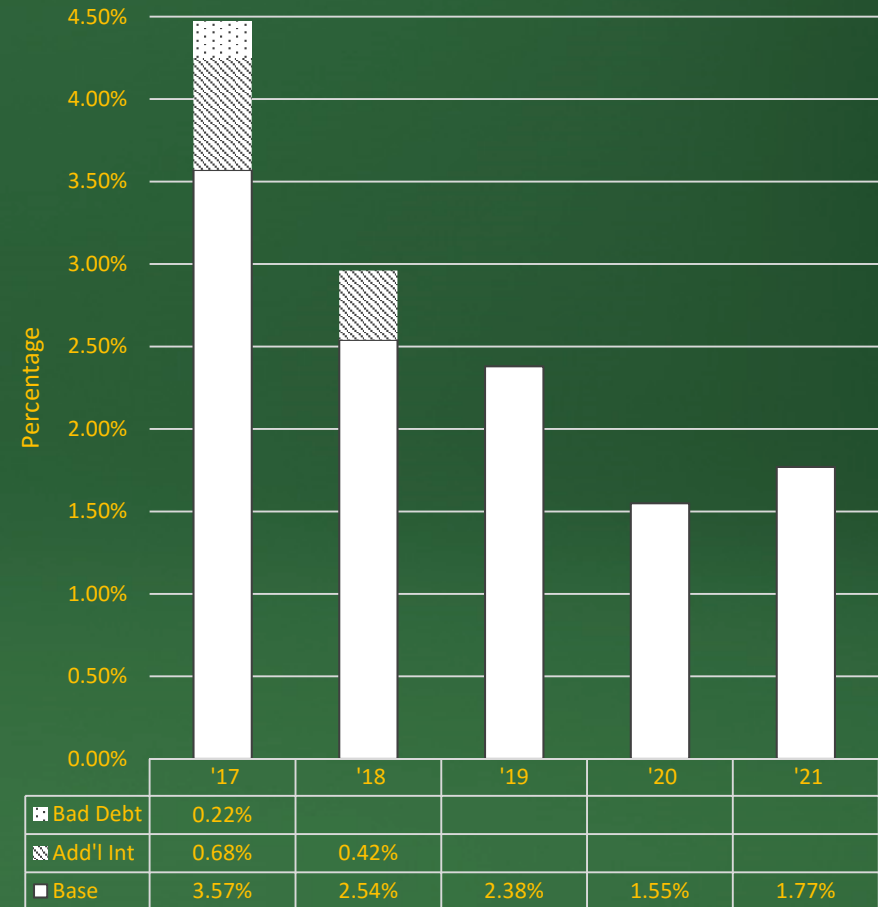


Return on Assets

Base Case

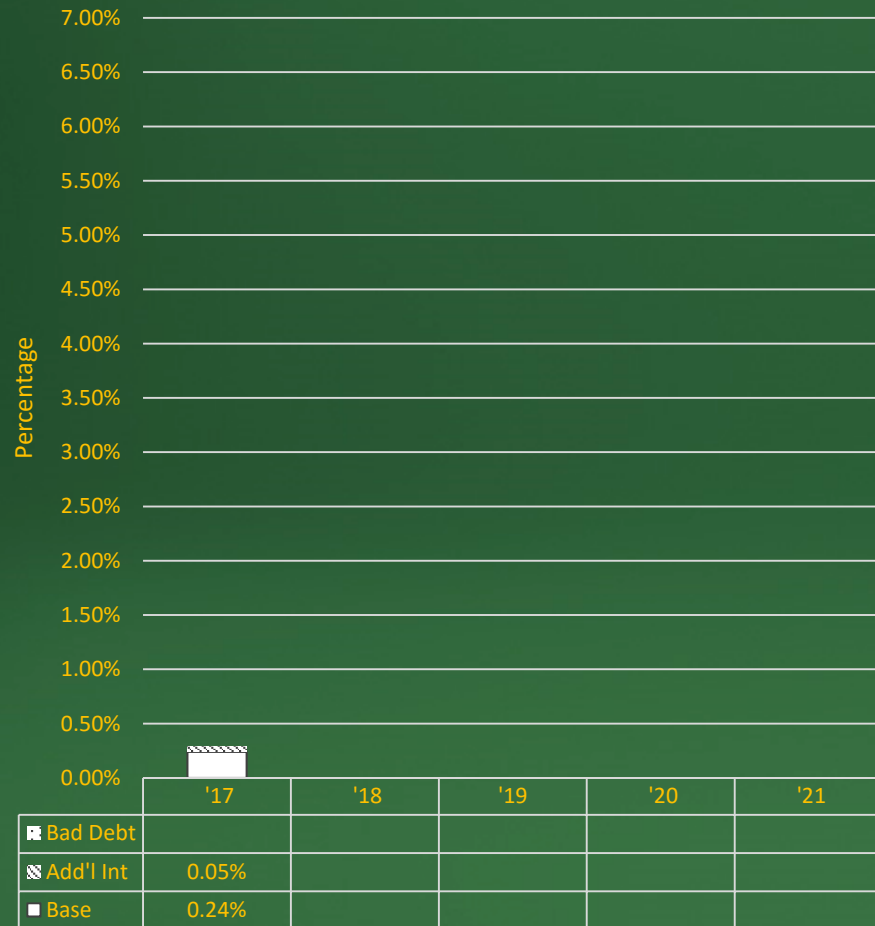


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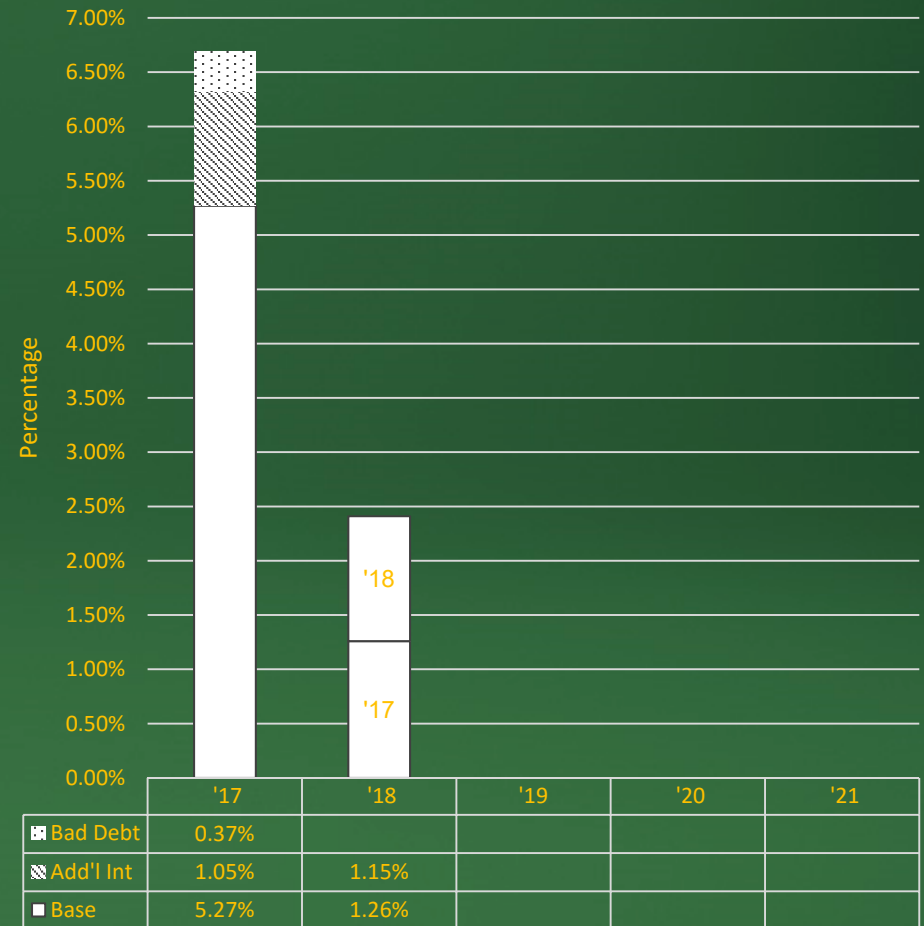


Debt to Equity

Base Case

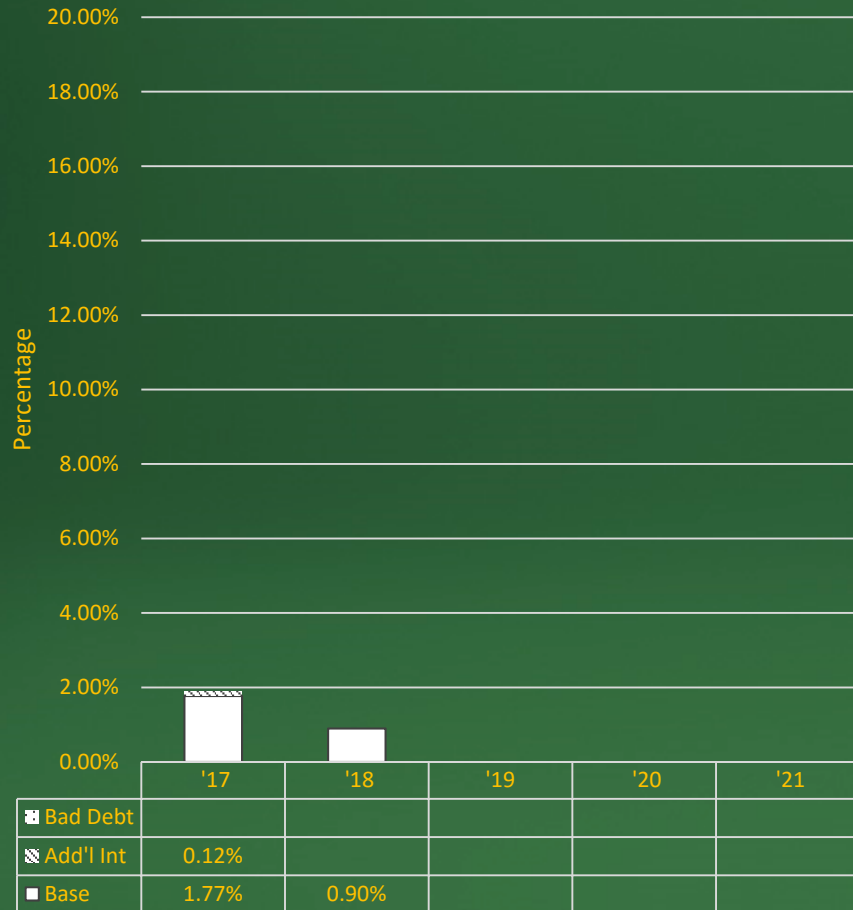


Severe Case

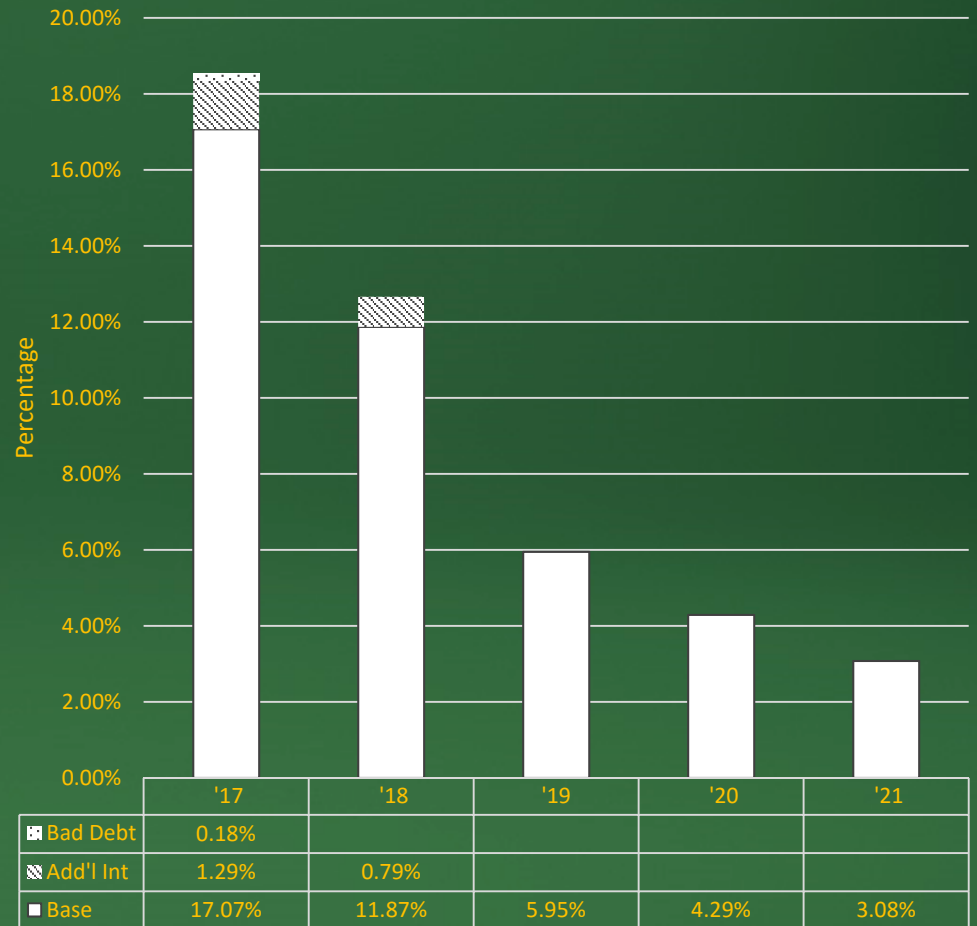


Debt Service Coverage*

Base Case

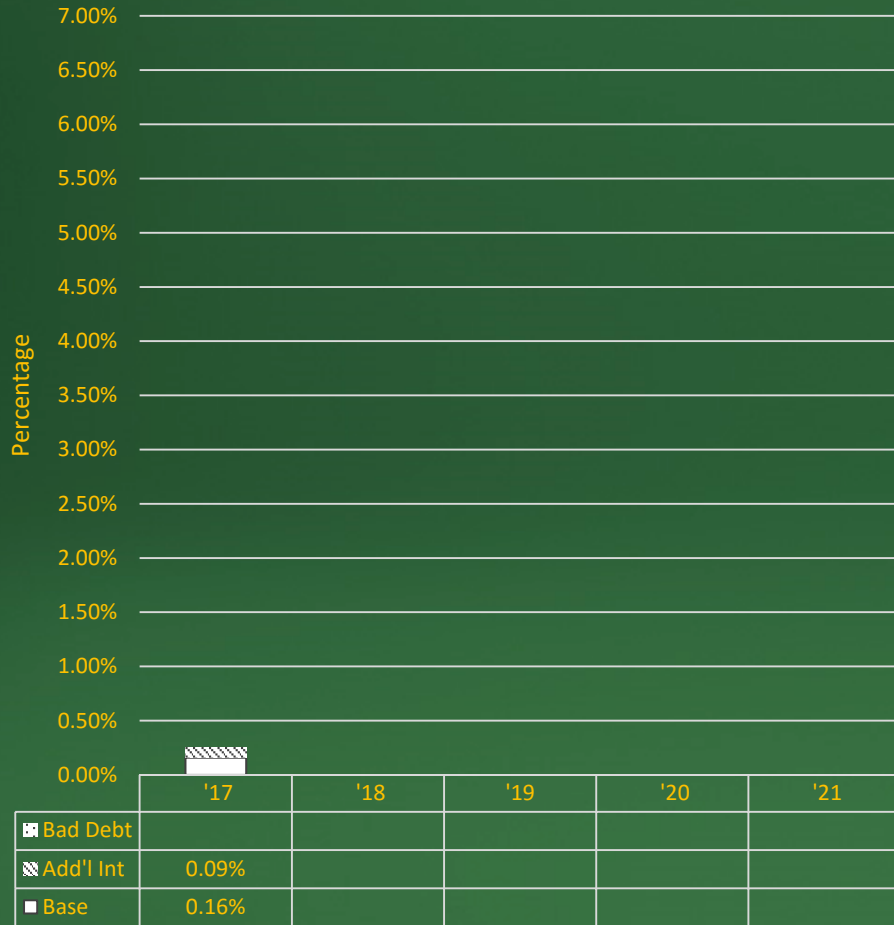


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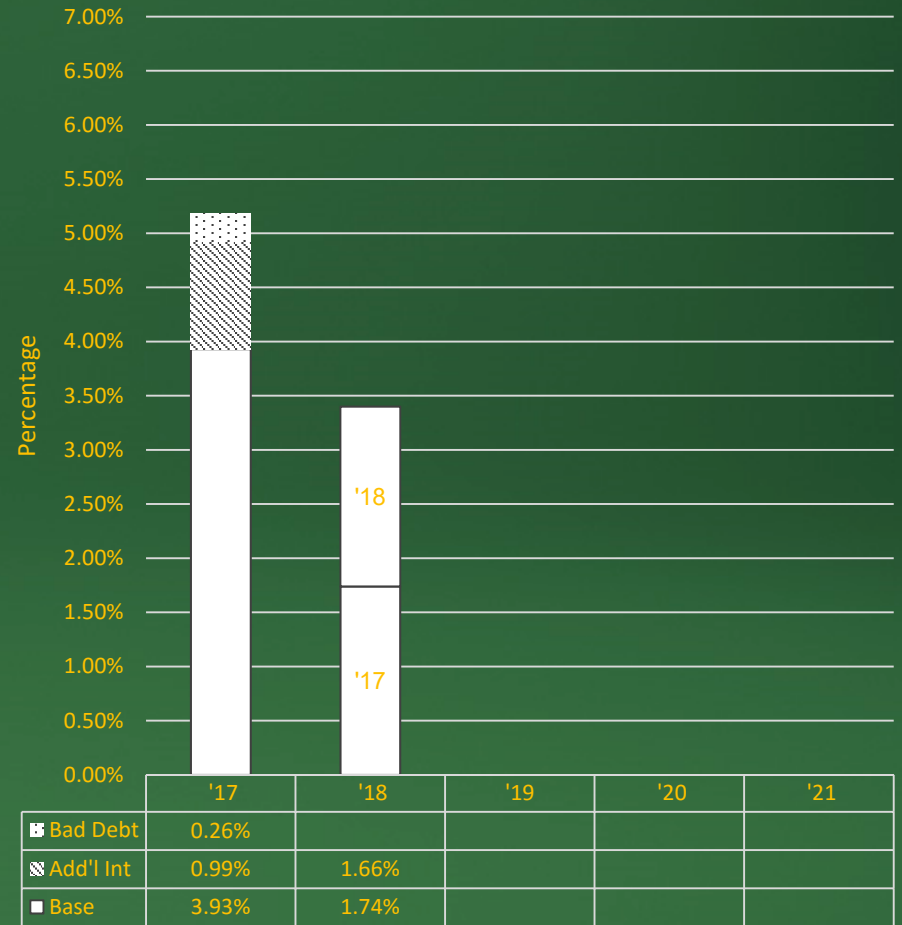


Current Ratio*

Base Case

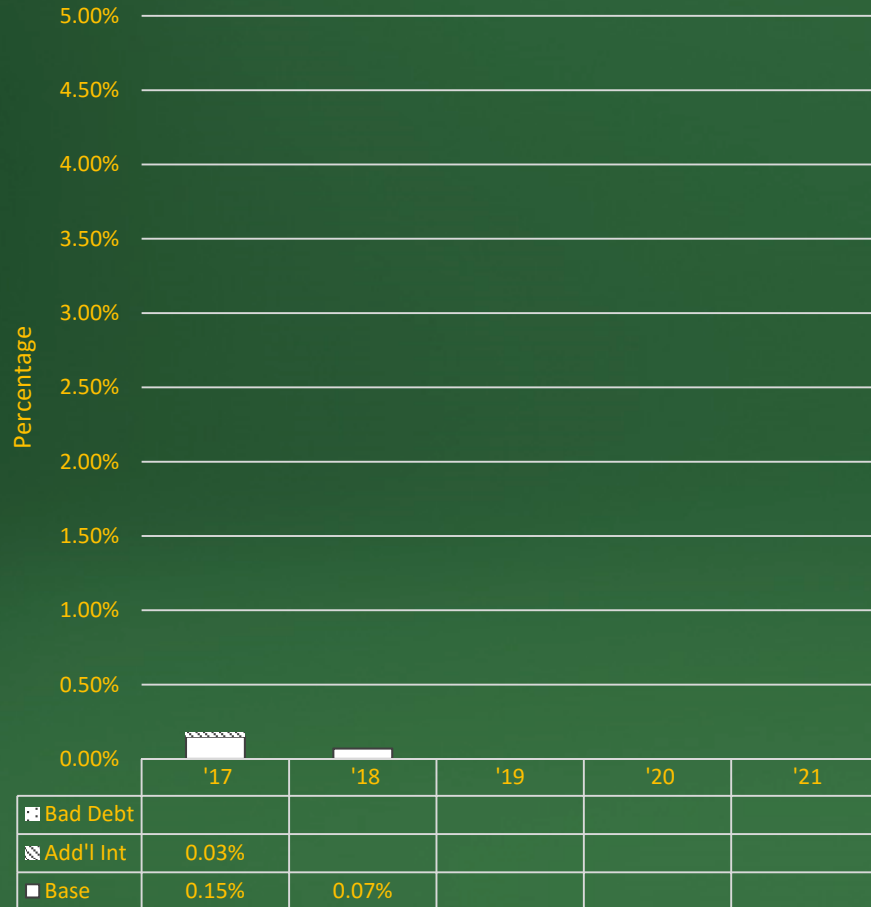


Severe Case

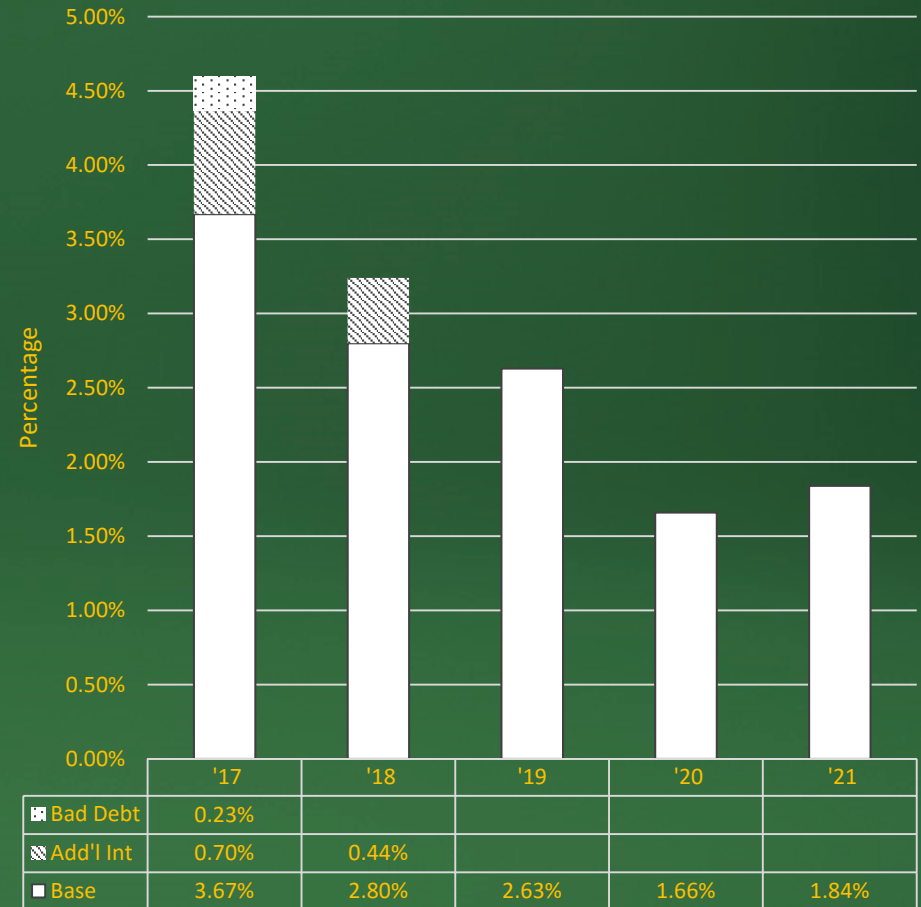


Local Return on Sales

Base Case

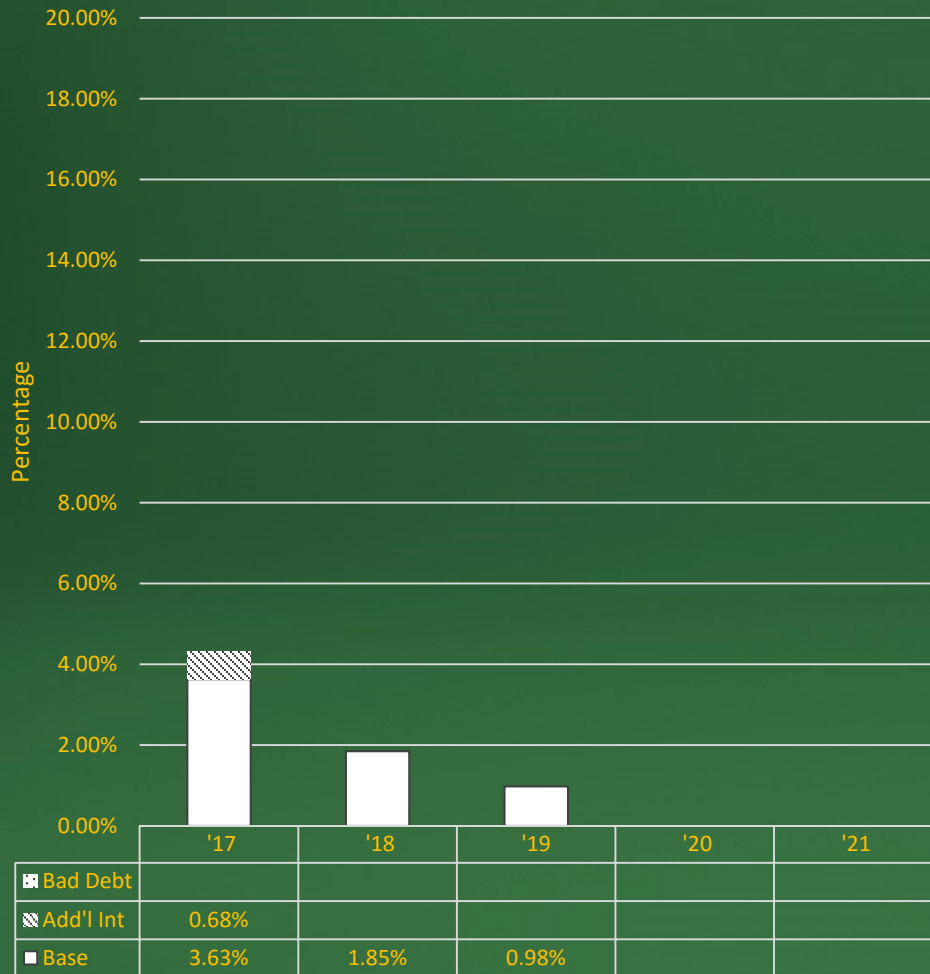


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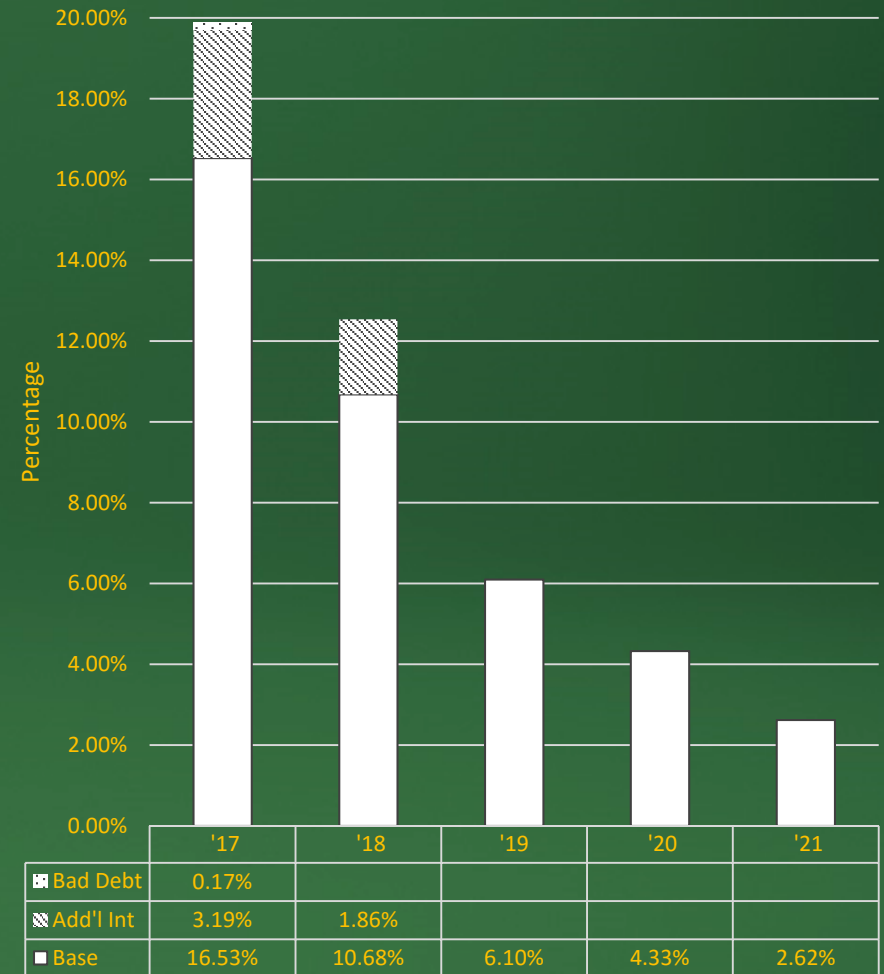


Interest Coverage Ratio

Base Case

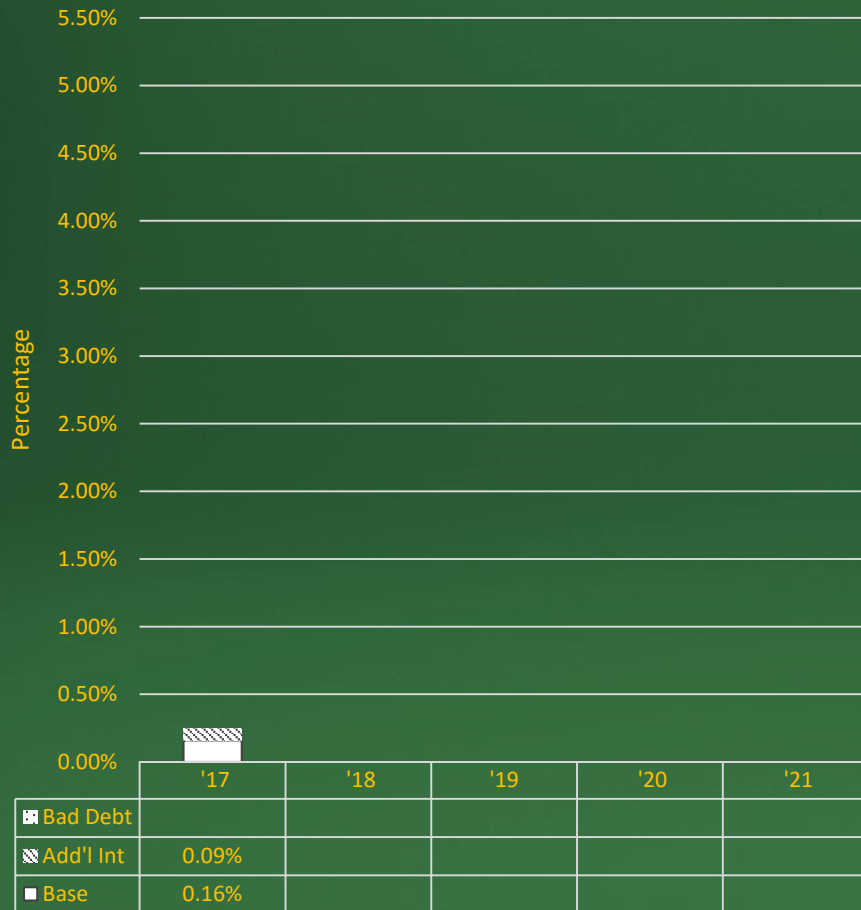


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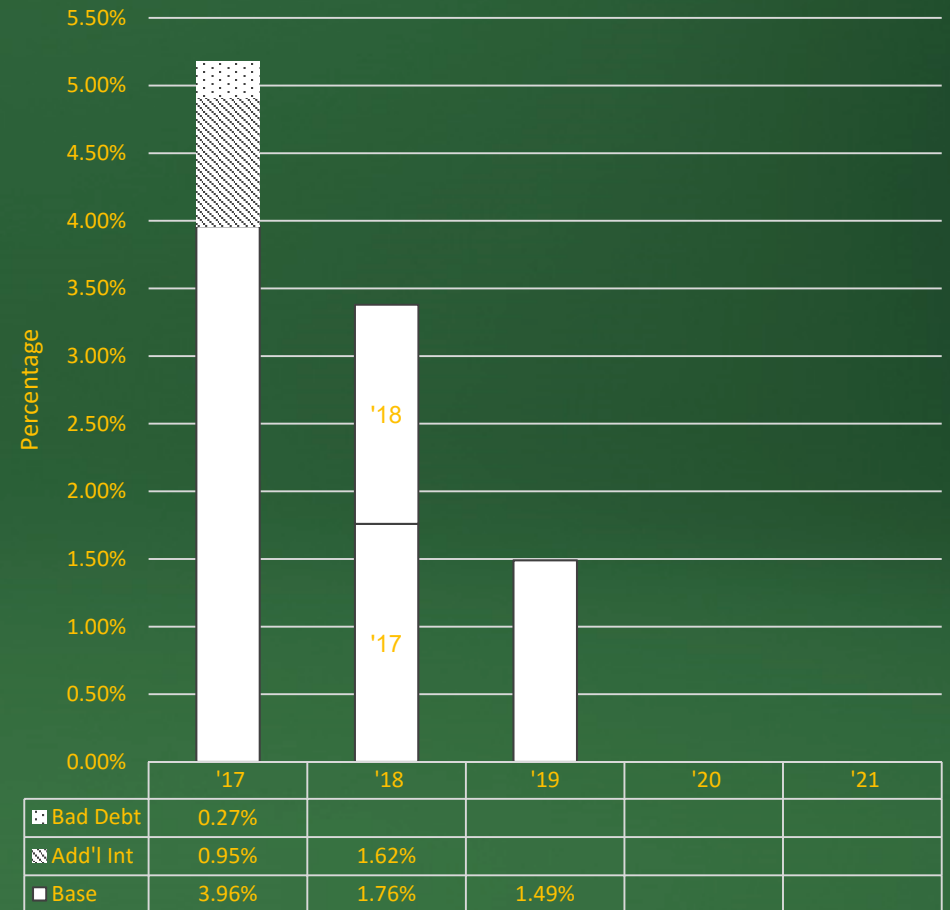


Working Capital to Total Sales

Base Case

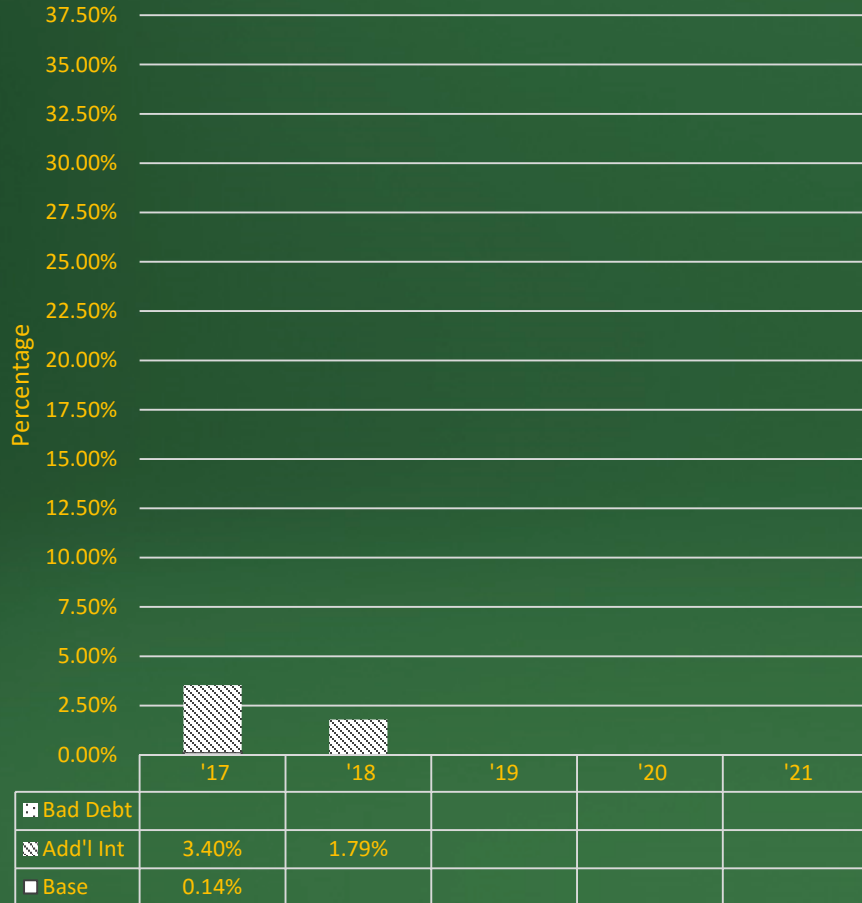


Severe Case

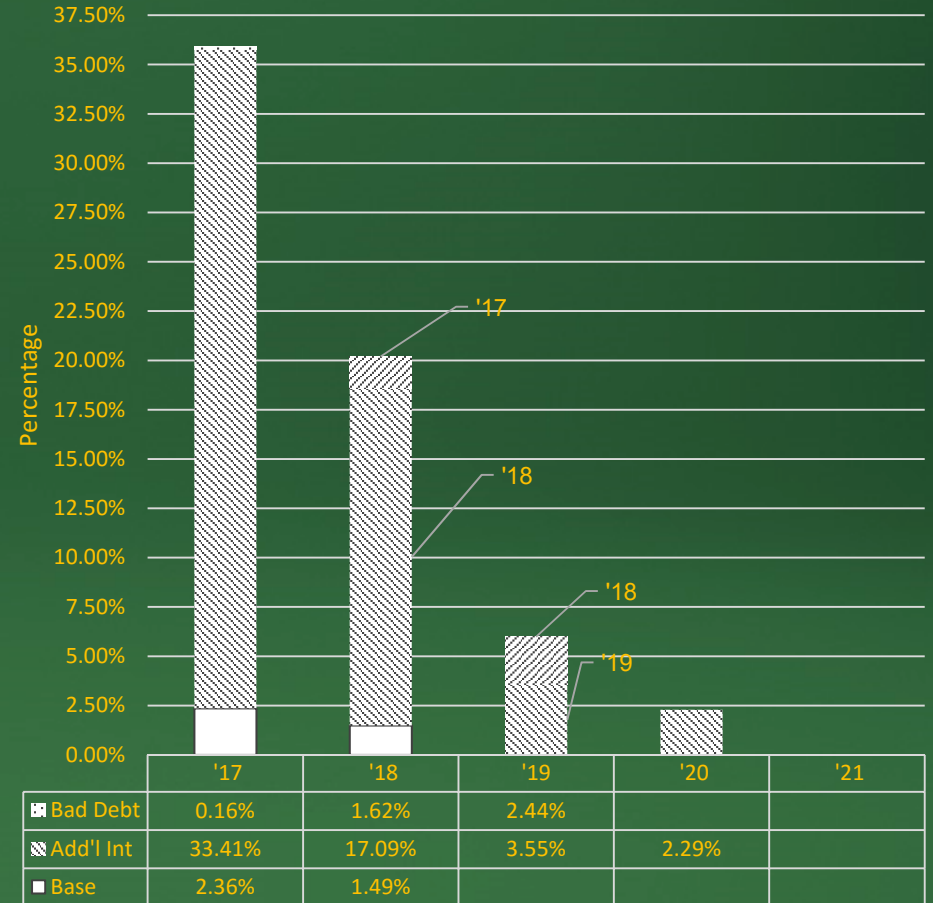


Long Term Debt to Equity

Base Case



Severe Case



Conclusions

- We defined sources of financial risk as:
 - Base interest rate, credit rating, and bad debt
- Lender ratios seem to capture financial risk better
 - Lender ratios specifically measure interest expense
 - Variable interest rate on term debt
- Lenders
 - Capturing desired sources of financial risk?
- Suggestions for future research
 - How do we measure probability of bad debt?
 - Suggestion – use aging of accounts receivable
 - Are there other sources of financial risk?
 - Empirically test the lender ratios on historical data

Questions?