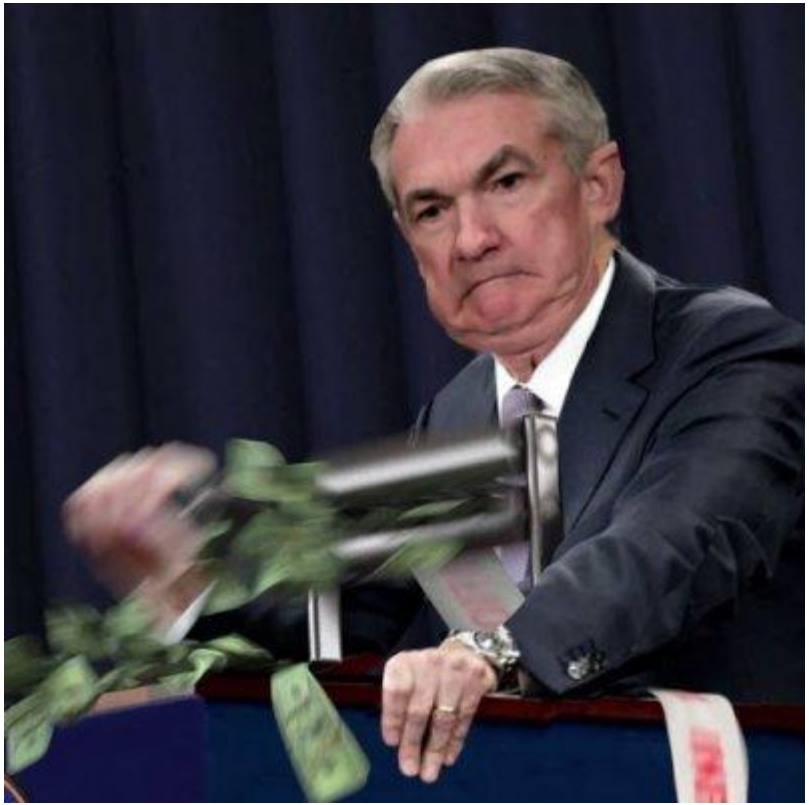
Application of ANCOVA in Analyzing Profitability Between Market Industries

James Hopham

Background

- Financial Markets
  - Sectors
    - Basic Materials, Communication Services, Consumer Staples, Healthcare, Information Technology, Financials, Real Estate, Consumer Discretionary, Industrials, Utilities, Energy
  - Industries
- Stocks
  - Shares
  - ETF
  - Market Capitalization: (stock price)(#shares outstanding)



Project Data

- FIN 425 - Student Investment Fund
- Capital IQ
- Large-Cap
  - X > $14.5 billion
- Mid-Cap
  - $5.2 billion < X < $14.5 billion
- Small-Cap
  - $850 million < X < $5.2 billion
- Publicly Traded
- Operating
- Major U.S. Exchanges
- Sectors: Information Technology and Healthcare

CAL STATE EAST BAY

Dataset

Company		Year	Rev/sh	Rev %	EPS	Margin (%)	Div/sh	Sh. Out	Op CF	CapEx	FCF/sh	Debt Issued	Debt Repaid	Net Debt/sh	FCFE/sh	Stock price
NasdaqGS:AAPL	1	**t-10**	6.78		1.42	32.62	0.42	25,193	53,666	-8,165	1.81	16,896	0	0.67	2.48	
Apple Inc.	2	**t-9**	7.79	14.86%	1.61	33.07	0.47	23,459	59,713	-9,571	2.14	18,266	0	0.78	2.92	**Profitability (35%)**
	3	**t-8**	10.48	34.50%	2.31	35.29	0.52	22,301	81,266	-11,247	3.14	29,305	0	1.31	4.45	**Size (20%)**
	4	**t-7**	10.11	-3.53%	2.08	32.71	0.57	21,329	66,231	-12,734	2.51	24,954	-2,897	1.03	3.54	**Stability (15%)**
	5	**t-6**	11.16	10.40%	2.30	31.19	0.62	20,537	64,225	-12,451	2.52	32,514	-3,500	1.41	3.93	
	6	**t-5**	13.99	25.36%	2.98	30.80	0.72	18,982	77,434	-13,313	3.38	6,969	-6,537	0.02	3.40	**Efficiency (15%)**
	7	**t-4**	14.64	4.62%	2.97	29.39	0.79	17,773	69,391	-10,495	3.31	6,963	-14,782	-0.44	2.87	
	8	**t-3**	16.15	10.30%	3.28	28.17	0.83	17,002	80,674	-7,309	4.32	16,091	-13,592	0.15	4.46	
	9	**t-2**	22.30	38.10%	5.61	32.87	0.88	16,406	104,038	-11,085	5.67	21,415	-8,750	0.77	6.44	**Solvency (7.5%)**
	10	**t-1**	24.79	11.17%	6.11	33.10	0.93	15,908	122,151	-10,708	7.01	9,420	-9,543	-0.01	7.00	**Profitability (7.5%)**
	11	**TTM**	24.56	-0.93%	5.95	32.29	0.96	15,634	113,072	-12,085	6.46	9,678	-19,915	-0.65	5.80	**Consistency**
		5-yr ave		**11.91%**	**14.8%**		**5.8%**	**-3.8%**			**13.84%**				**11.29%**	
		10-yr ave		**13.73%**	**15.4%**		**8.6%**	**-4.7%**			**13.59%**				**8.89%**	

Dataset

- Relative Valuation
- EPS = (Earnings) / (Shares Outstanding)
  - PE = (Stock Price)/(EPS)
    - Based on capital expenditures
- Net Income (e.g. Earnings)
  - Retained Earnings
  - Dividends or Stock Buyback
    - Issue: includes both cash and non-cash items
      - E.g. Misrepresentation of income with interpretation of timing of AR and AP, and depreciation/amortization

Dataset

- Operating Cash Flow
  - Net Income + (Non-Cash Expenses) - (Non-Cash Revenue)
    - Excludes non-cash items for both tangible and intangible assets
  - Depreciation
  - Amortization
  - AR, AP
- Free Cash Flow
  - (Operating Cash Flow) - (Full Value of Capital Expenditures)
    - E.g. all leftover cash
    - Does not get influenced by non-cash item manipulation
    - Value will be high at early stages of a company
    - FCFE = (FCFE) / (shares outstanding)
      - E.g. we will use average of 6 years for (stock price)/FCFE

Dataset

- Enterprise Value
  - (Value of Equity) +(Debt) - Cash
  - Some people use EV/EBITDA
- Stability:
  - (Value of Next Year Dividend) / ((Constant Cost of Equity Capital) - (Constant Growth Rate in Perpetuity))
- Efficiency
  - Earnings Conversion
    - (6-year Average EPS) / (6-year Average Revenue)
  - True ROA
    - (6-year Average FCFE) / (Tangible Assets)
  - Margin
- Debt Load
  - (6-year Average Net Debt) / (6-year Average FCFE)

Data Wrangling

- Original Dataset: 534 rows and 30 columns
- Final Dataset: 487 rows and 6 columns
- Missing Data
  - Drop rows missing too much data
    - Small Cap
  - Take local averages of companies in same market cap size

midcap pv fcfe average	-3.48
midcap earnings average	
midcap roa average	
midcap debt average	-0.02

Data Wrangling

- Drop EV/EBITDA
  - Too hard to evaluate between market caps bc of variability in small caps so better to consider profitability using p/fcfe
- Drop 10-year margin
  - Too many issues

Initial Model

H_0: There is no difference in means of profitability among the different market industries

Response Variable:

- Profitability
  - Terminal P/FCFE

Main Effect

- Primary Industry

Blocking Factor

- Market Cap

H_a: There exists a difference in means of the profitability of a company among the different market industries

Covariates:

- Solvency
  - Debt Load
    - (6-year Average Net-Debt)/(6-year Average FCFE)
- Efficiency:
  - Earnings Conversion
    - (6-year Average EPS) / (6-year Average Revenue)
  - True ROA
    - (6-year Average FCFE) / (Tangible Assets)

Summary Statistics

	Hardware	Health Care Equipment and Services	Pharmaceuticals, Biotechnology and Life Sciences	Semiconductors	Software
Counts	66	103	127	54	137

Unbalanced

Results

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Market_Cap	2	48406.504	24203.252	1.88	0.1543
Industry_Group	4	72745.021	18186.255	1.41	0.2296
True_ROA_Fixed_Value	1	166.075	166.075	0.01	0.9097
True_ROA_*Industry_G	4	218085.375	54521.344	4.23	0.0023
Debt_Load_Fixed_Valu	1	669.178	669.178	0.05	0.8199
Debt_Load*Industry_G	4	21970.882	5492.721	0.43	0.7901
True_ROA_*Debt_Load_	1	95665.800	95665.800	7.42	0.0067
True_R*Debt_L*Indust	4	1386716.059	346679.015	26.87	<.0001

R-Square	Coeff Var	Root MSE	P_v_FCP_fixed_values Mean
0.306997	2235.389	113.5816	5.081068

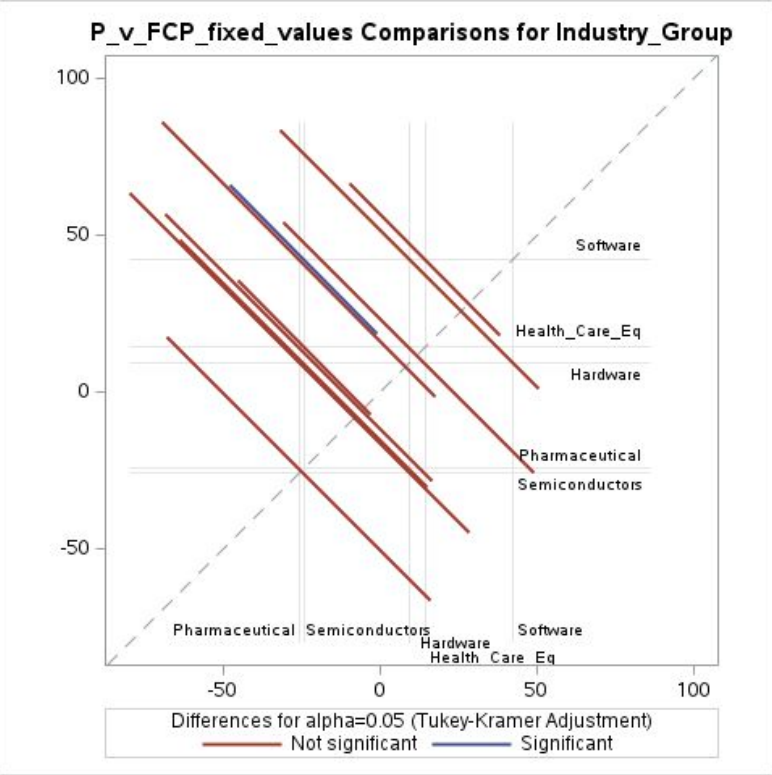
Results

Remove True ROA

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Market_Cap	2	55697.2392	27848.6196	1.64	0.1950
Industry_Group	4	108450.7761	27112.6940	1.60	0.1738
Debt_Load_Fixed_Valu	1	840.6198	840.6198	0.05	0.8240
Debt_Load*Industry_G	4	230403.4362	57600.8591	3.39	0.0094

R-Square	Coeff Var	Root MSE	P_v_FCP_fixed_values Mean
0.068563	2564.141	130.2857	5.081068

Results


P_v_FCP_fixed_values Comparisons for Industry_Group
100
50
0
-50
Software
Health_Care_Eq
Hardware
Pharmaceutical
Semiconductors
Pharmaceutical
Semiconductors
Hardware
Health_Care_Eq
Software
-50
0
50
100
Differences for alpha=0.05 (Tukey-Kramer Adjustment)
Not significant
Significant

Testing Assumptions

Homogeneity of variances

The GLM Procedure

Levene's Test for Homogeneity of P_v_FCP_fixed_values Variance ANOVA of Squared Deviations from Group Means					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Industry_Group	4	1.471E11	3.677E10	0.69	0.6012
Error	482	2.58E13	5.352E10		

Testing Assumptions

Tests for Normality				
Test	Statistic		p Value	
Shapiro-Wilk	W	0.346221	Pr < W	<0.0001
Kolmogorov-Smirnov	D	0.323938	Pr > D	<0.0100
Cramer-von Mises	W-Sq	16.45732	Pr > W-Sq	<0.0050
Anderson-Darling	A-Sq	82.3214	Pr > A-Sq	<0.0050

Interpretation/Further Study

- Fail to reject the null; there is no significant difference in profitability among the individual sectors
- Further Study for Stock Strategies
  - Portfolio Optimization
  - Black-Scholes Model
  - New Metrics
  - Time-Series
  - Markov Chains

Works Cited

- https://www.investopedia.com/terms/c/costofequity.asp
- https://www.bench.co/blog/tax-tips/depreciation
- https://www.techtarget.com/whatis/definition/CAPEX-capital-expenditure#:~:text=A%20capital%20expenditure%2C%20or%20Capex,to%20foster%20its%20future%20growth.
- https://corporatefinanceinstitute.com/resources/accounting/capital-expenditures/
- https://www.capitaliq.com/ciqdotnet/login-sso.aspx?bmctx=05D50DFC1A22D156FEC7A630EB2EFA98&enablePersistentLogin=true&OAUTH_SSO_ENC_KEY=C57DBB5C08DA42B6E90C86AF0C895A9B1C0828BB0FD48E2881852858161950DE&password=secure_string&OAUTH_TOKEN_RESPONSE=header&contextType=external&IS_OAUTH_OAM_SSO_LINK_ENABLED=true&OAUTH_SSO_ID_DOMAIN=SPGLBDomain&IS_OAUTH_USER_ASSERTION_ENABLED=true&OverrideRetryLimit=0&env=WAM12C&username=string&challenge_url=https%3A%2F%2Fwww.capitaliq.com%2Fciqdotnet%2Flogin-sso.aspx&request_id=885773012718422643 2&authn_try_count=0&locale=en_US&resource_url=https%253A%252F%252Fwww.capitaliq.com%252FCIQDotNet%252Flogin.aspx