Backtesting Project

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Agenda

1. Our Factors
2. Factor Selection
3. Our Model
4. Portfolio Performance & Comparison

Our Factors

Cash flow volatility	Calculated: 16-month std dev of cash flow margin	Sign: -	Huang (2009)
Inventory turnover	Direct: (from WRDS financial ratios) COGS as a fraction of the average Inventories based on the most recent two periods	Sign: +	Gaur and Kesavan (2009)
Enterprise value	Direct: (from WRDS financial ratios)	Sign: -	Crawford, Gray, and Vogel (2019)
ROIC	Calculated: ROIC = operating income after tax/ invested capital Then Avg of 5Y/ std dev of 5Y	sign : +	Heegaard and Sorensen (2013)

Factors Removed

- Factors removed due to opposite signs and/or low t-statistics (Less than 1.5), example shown

Factor	Description	T-stat	Exp Sign/ Actual
Size	Log of Market Capitalization	.235	-/+
SG	%change in net sales turnover	-2.591	+/-
ROE	Ratio of Equity income/ book value of equity	.383	+/+
DP	Dividend/Price Ratio	-3.247	+/-

Factors Chosen

All factors chosen due to t-stat above 1.5 and/or sign was as expected

Factor	Description	T-stat	Sign
Mom (Momentum)	Cumulative continuously compounded returns from month t-12 to t-2	21.38	+
AC (Accruals)	Change in current assets - change in cash & short-term investments	-2.43	-
IG (Investment Growth)	% change in capex	-3.47	-
NS (Net Stock Issuance)	Log of ratio of split-adjusted shares outstanding at FYE t-1 and t-2	-2.24	-
AG (Asset Growth)	% change in total assets	-3.18	-
BM (Book to Market)	Ratio of Book-to-Market value	9.45	+
Evm (Enterprise Value Multiple)	Multiple of Enterprise Value to EBITDA	-0.38	-
Cf_vol (Cash Flow volatility)	Calculated: 16-month std dev of cash flow margin	-1.26	-

Factor Creation

Cash Flow Volatility (Huang 2009)

- **We would expect the sign to be negative**
- With increased volatility, there is a greater risk associated with the company's future CF
- In turn, Investor demands higher return , which lower stock price & future returns

Calculation:

- Rolling standard deviation of cash flow margins over the past 16 months

Inventory Turnover - Gaur & Kesavan (2009)

- **We would expect the sign to be positive**
- A higher inventory turnover leads to sales growth, therefore higher returns

Calculation:

- COGS as a fraction of the average Inventories based on the most recent two periods

Enterprise Value - Crawford, Gray, and Vogel (2019)

- **We would expect the sign to be negative**
- Relationship is similar to size factor, as market value and enterprise value are related
- As size (and enterprise value) increases, the expected future return decreases
- Stocks of smaller size (lower EV) have higher expected returns

Calculation

- From WRDS financial ratios - multiple of enterprise value to EBITDA

ROIC - Heegaard & Sorensen (2013)

- **We would expect the sign to be positive**
- ROIC is useful when determining how well a company allocates its capital to profitable projects or investments
- If the ROIC is higher than the WACC, that means the company creates positive value
- If the ROIC is lower than the WACC, that means the company's value is declining

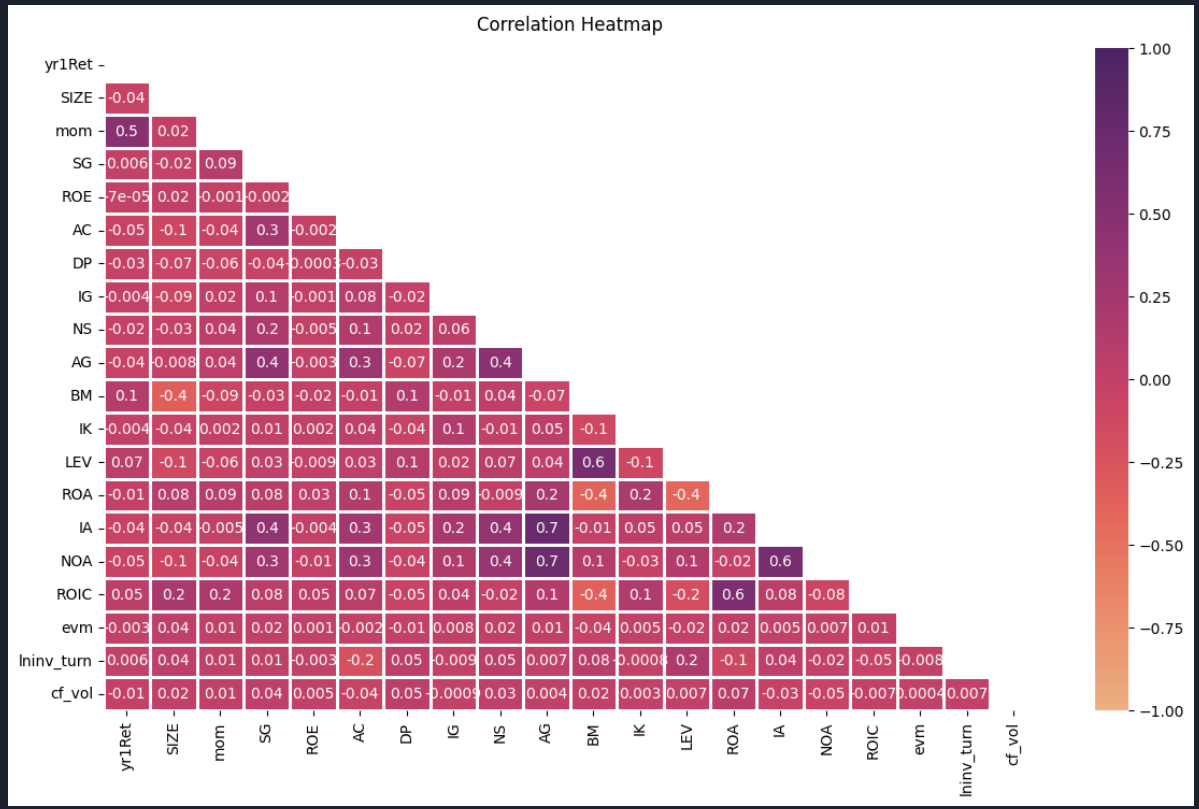
Calculation:

- ROIC = Net Operating Profit After Tax / Invested Capital

Factor Selection

Correlation Between Factors

- Most factors have low correlation with one another
- Factors that had high correlation included: AG and IA, AG and NOA
- Because of low correlation overall, there is assumption of no multicollinearity



In Sample Model - Factor Premia

- Criteria for Factors: T-value above 1.5 and/or sign meets theoretical expectation
- Mom and BM have larger means when compared to other factors
- On average, standard deviation of all factors is roughly the same

	mean	std_dev	tvalues
Intercept	0.160480	0.154019	5.985551
SIZE_Z	0.001519	0.037144	0.234917
mom_Z	0.215975	0.058012	21.386730
SG_Z	-0.009158	0.020306	-2.590914
ROE_Z	0.002000	0.029978	0.383211
AC_Z	-0.007976	0.018861	-2.429313
DP_Z	-0.009660	0.017088	-3.247413
IG_Z	-0.011333	0.018752	-3.471819
NS_Z	-0.005446	0.013956	-2.241628
AG_Z	-0.011698	0.021111	-3.183178
BM_Z	0.059450	0.036139	9.450110
IK_Z	0.010056	0.017765	3.251973
LEV_Z	0.002914	0.034798	0.481006
ROA_Z	0.000375	0.028450	0.075769
IA_Z	0.011890	0.023836	2.865609
NOA_Z	-0.000265	0.017800	-0.085642
ROIC_Z	0.011741	0.022673	2.974695
evm_Z	-0.001239	0.018962	-0.375435
lninv_turn_Z	0.000075	0.014362	0.030003
cf_vol_Z	-0.004610	0.021057	-1.257760

Portfolio Performance & Comparison

Portfolio’s Returns

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Long portfolio annualized return is 13.44%
Short portfolio annualized return is 10.58%
Long short portfolio annualized return is 1.98%
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- Long portfolio generated the highest returns
- Our short portfolio performed extremely well - the positive return indicates that the securities value has declined as hoped and profits were made
- The relatively low returns of the Long short portfolio could be due to the diversification of the portfolio, while it reduces risk the returns can also decrease

Long Portfolio Performance

	Long CAPM	Long FF3	Long CH4
Intercept	0.0004	0.0016	0.0014
	(0.0019)	(0.0017)	(0.0017)
MKT	1.0624***	0.9896***	0.9992***
	(0.0506)	(0.0498)	(0.0498)
SMB		0.3630***	0.3641***
		(0.0659)	(0.0664)
HML		0.2177***	0.2452***
		(0.0592)	(0.0612)
MOM			0.0421
			(0.0533)
R-squared	0.7873	0.8587	0.8595
R-squared Adj.	0.7847	0.8534	0.8524

Standard errors in parentheses.
* p<.1, ** p<.05, ***p<.01

- Across all models, the **intercept** is not statistically significant
- **MKT** is statistically significant at 1% level across all models
- **SMB** is statistically significant at 1% level in the Long FF3 and Long CH4
- **HML** is statistically significant at 1% level in the Long FF3 and Long CH4
- **MOM -** not statistically significant, not a significant predictor of our model
- R squared is high across all models indicating that the variation in portfolio returns can be explained by our factors

Long-Short Portfolio Performance

	Long Short CAPM	Long Short FF3	Long Short CH4
Intercept	0.0019	0.0009	-0.0002
	(0.0025)	(0.0024)	(0.0026)
MKT	0.0065	0.0643	0.1176
	(0.1021)	(0.0925)	(0.0887)
SMB		-0.2855***	-0.2793***
		(0.1055)	(0.1020)
HML		-0.2976**	-0.1440
		(0.1216)	(0.1048)
MOM			0.2346**
			(0.1144)
R-squared	0.0001	0.1574	0.2146
R-squared Adj.	-0.0121	0.1258	0.1748

Standard errors in parentheses.
* p<.1, ** p<.05, ***p<.01

- Across all models, the **intercept** is not statistically significant
- **MKT** is not statistically significant across all models
- **SMB** is statistically significant at 1% level in the LS FF3 and LS CH4
- **HML** is statistically significant at 5% level in the LS FF3
- **MOM** - is statistically significant at 5% level in the LS CH4
- R squared is low across all models indicating that the variation in portfolio returns can not be explained by our factors

LS vs Long Only

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Long portfolio annualized Sharpe ratio is 0.99
Short portfolio annualized Sharpe ratio is 0.72
Long short portfolio annualized Sharpe ratio is 0.22
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- The Long portfolio has a Sharpe ratio of almost 1, classifying its risk adjusted returns to be “good”
- The Short portfolio has a Sharpe ratio of .72, meaning that it the risk adjusted returns are relatively not as good as the long portfolio
- The LS Sharpe ratio is extremely low indicating that the risk adjusted returns are very poor, and this portfolio is not performing as well as the other two