

VALUE INVESTING

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▼ -3.59	▼ -1.26	▲ 2.40	▼ -2.42	▲ 8.29	▲ 19.43	20.78
116.00	114.64	113.28	114.75	109.13	103.99	99.10
106.70	112.00	115.00	109.50	119.00	115.00	
-9.29	▼ -2.64	▲ 1.71	▼ -5.25	▲ 5.26	▲ 15.01	▲ 15.90
2.90	3.06	3.52	3.04	3.85	4.20	4.4
3.50	3.60	3.90	3.52	4.25	4.50	5.1
0.60	▲ 0.54	▲ 0.37	▲ 0.48	▲ 0.39	▲ 0.29	▲ 0.6
1.36	57.65	70.07	59.50	65.81	66.85	67.
.93	56.50	65.84	59.93	62.72	65.00	70
5.7	▼ -1.14	▼ -4.22	▲ 0.42	▼ -3.09	▼ -1.84	▲ 2
48	102.30	103.21	103.59	102.42	101.71	97
10	98.70	102.00	106.00	100.00	100.00	11
8	▼ -3.59	▼ -1.26	▲ 2.40	▼ -2.42	▲ 8.29	▲ 19.43
7	116.00	114.64	113.28	114.75	109.13	99.10
	106.70	112.00	115.00	109.50	115.00	
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	2.90	3.06	3.52	3.04	3.85	
	3.50	3.60	3.90	3.52	4.25	
	▲ 0.60	▲ 0.54	▲ 0.37	▲ 0.48	▲ 0.39	

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Research Methodology



High book-to-market firms



Investors usually pay less attention to these firms



Not included in analyst forecast and stock recommendations



Voluntary disclosure viewed as uncredible

Use of financial signals

An opportunity to yield abnormal return by differentiating strong and weak firms

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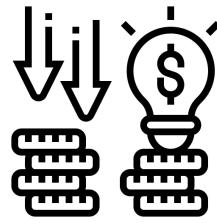
Selection of accounting signals

Profitability



ROA
CFO
Change in ROA
Accrual

Leverage



Change in leverage
Change in liquidity
Issuance of common equity

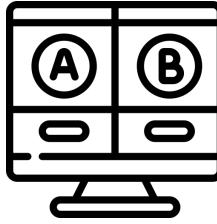
Operating Efficiency



Change in gross margin ratio
Change in asset turnover ratio

Selection of market signals

Book-to-market ratio



Reflects the true valuation of the company.
Undervalued if BM is high

Market Capitalization



Preferred measurement of size for investors
Price change more volatile if small market cap

Accounting Signals



ROA
CFO
Change in ROA
Accrual

Measures the firm's ability to generate funds internally despite its poor performance in the past



Change in leverage
Change in liquidity
Issuance of common equity

Changes in a firm's capital structure and its ability to meet future debt obligations / Capability to generate internal funds



Change in gross margin ratio
Change in asset turnover ratio

Measures how a firm utilizes its assets to generate profit, any potential improvements in the firm's management on cost and efficiency

Research Methodology

Research Design

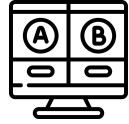
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Market Signals



Book-to-market ratio

Reflects the true value of the company



Market Capitalization

Preferred measurement of size for investors

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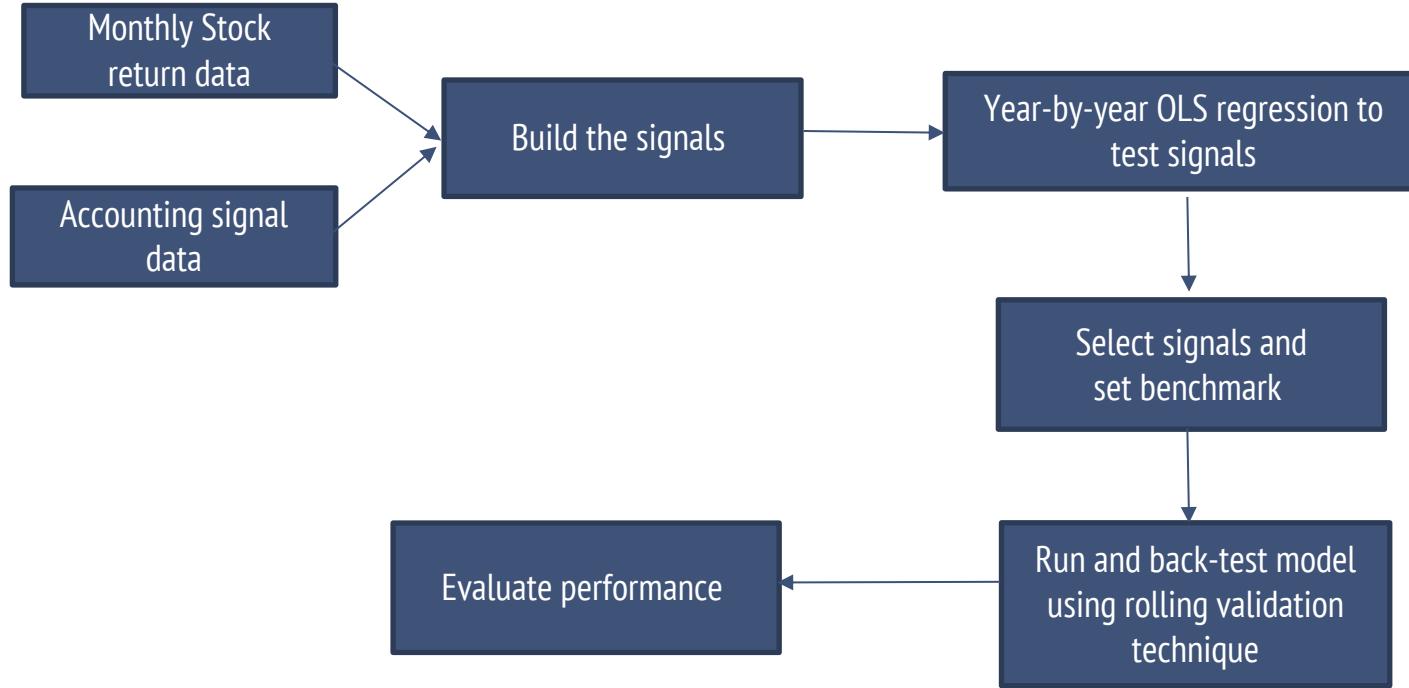
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Research Design



Overview of research design



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Data Collection

Collected 20 years of data from Compustat with listed variables:

Symbol	Definition	Symbol	Definition
IB	Income before extraordinary items	DLTT	Total long-term debt
AT	Total assets	ACT	Total current assets
OANCF	Operating activities net cash flow	LCT	Total current liabilities
GP	Gross profit	MKVAL	Total market value (fiscal)
REVT	Total revenue	LT	Total liabilities
CSHI	Common share issued		

Ratio Computation

Financial statement signals	Computation	1	0
Profitability	F_ROA	ROA = IB/Beg. AT	ROA is positive
	F_CFO	CFO = OANCF/Beg. AT	CFO is positive
	F_ΔROA	ΔROA = current year's ROA - prior year's ROA	ΔROA > 0
	F_ACCRUAL	Accrual = (IB - OANCF)/Beg. AT	CFO > ROA / Accrual is negative CFO < ROA / Accrual is positive

Ratio Computation

Financial statement signals		Computation	1	0
Operating efficiency	F_ΔMARGIN	MARGIN = GP/REVT	ΔMARGIN is positive	ΔMARGIN is positive
	F_ΔATURN	CFO = OANCF/Beg. AT	CFO is positive	CFO is positive
Liquidity	F_ΔLEVER	ΔROA = current year's ROA – prior year's ROA	ΔROA > 0	ΔROA ≤ 0
	F_ΔLIQUID	Current ratio = ACT/LCT	current year's current ratio > prior year's current ratio	current year's current ratio > prior year's current ratio
	EQ_OFFER:	CSHI – Beg CSHI	the firm did not issue common equity in the year preceding portfolio formation	the firm issued common equity in the year preceding portfolio formation

F_score = summation of all binary scores (0 to 9)

Ratio Computation

- No. of outstanding shares multiplied by share price
- More volatile if smaller

Market Capitalization

- ($\text{Total assets} - \text{total liabilities}$) divided by Market value
- Cheapness of stock

Criteria

F_Score

BM Ratio

- Summation of 9 binary signals
- Ranged from 0 to 9 (worst to best)

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Statistical significance of signals

Result of year-by-year regression of yearly return against three variables

	t-stat	p-value
Constant	-0.0339	0.9733
F_SCORE	1.8212	0.0836
BM ratio	1.1678	0.2566
Market Capitalization	-0.8308	0.4159

Portfolio Formation



Strategy 1: Long-Only Portfolio

Signals	Selection Criteria	
Market Capitalisation	MKVALT >= 40th percentile	Follows G&C's research results
Book-to-market ratio	BM ratio >= 90th percentile	
F-score	F-score >= 8	Follows Piotroski's research results

Stocks in the portfolio take equal weightage

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Strategy 2: Long/Short Portfolio

Signals	Selection Criteria	
	Long	Short
Market capitalization	MKVALT \geq 40 th percentile	MKVALT \geq 40 th percentile
Book-to-market ratio	BM ratio \geq 90 th percentile	BM Ratio \leq 10 th percentile
F-score	F-SCORE \geq 8	F-SCORE \leq 1

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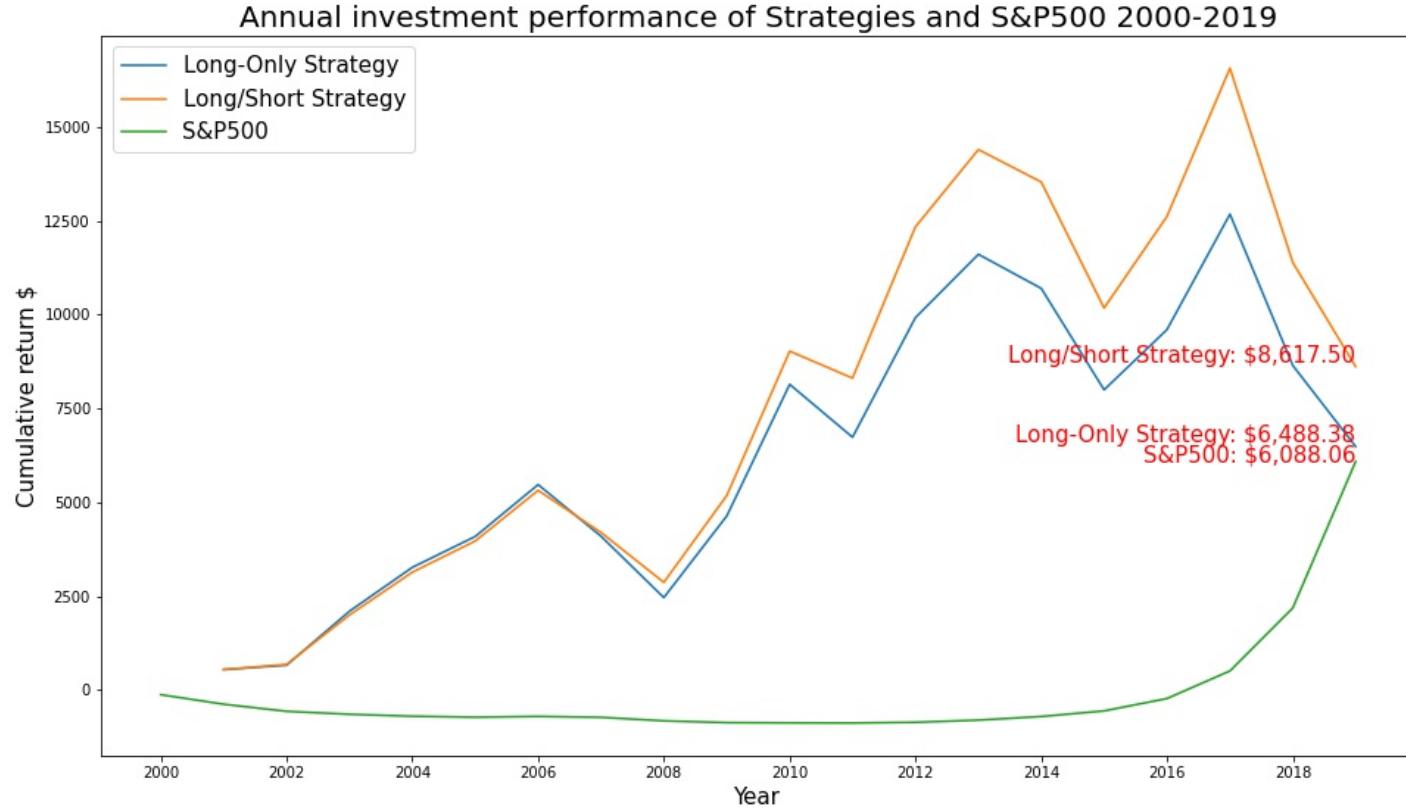
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Strategy 1 and 2 Performance



Strategy 1 and 2 Performance



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Strategy 3: Optimized Long/Short Portfolio

Iterative Parameter Tuning

Trying out all possible combinations of the 5 parameters to find the best set of parameters that produced the highest Compounded Annual Return.

Combination	Market_Cap	BM_Long	F_Long	BM_Short	F_Short
1	0.3	0.55	5	0.05	0
2	0.3	0.55	5	0.05	1
...
28349	0.95	0.95	9	0.45	3
28350	0.95	0.95	9	0.45	4

Strategy 3: Optimized Long/Short Portfolio

Signals	Selection Criteria	
	Long	Short
Market capitalization	MKVALT \geq 35 th percentile	MKVALT \geq 35 th percentile
Book-to-market ratio	BM ratio \geq 95 th percentile	BM Ratio \leq 5 th percentile
F-score	F-SCORE \geq 9	F-SCORE \leq 2

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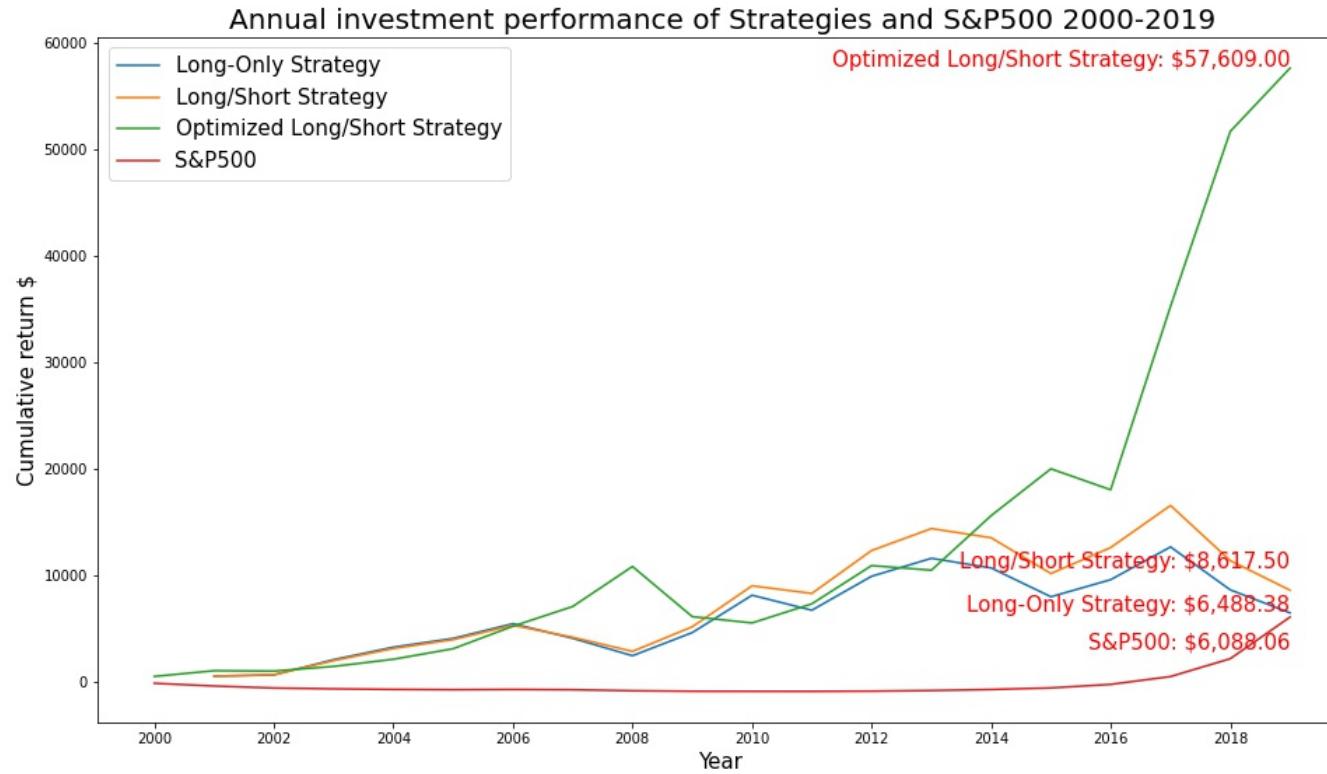
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Strategy 3 Performance



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Performance Evaluation



Performance metrics

	Strategy 1	Strategy 2	Strategy 3	S&P 500
CAGR	9.80%	11.37%	22.47%	9.45%
Sharpe ratio	0.42	0.47	0.87	0.34
Sortino ratio	1.63	1.60	1.59	1.53
Maximum drawdown	46.0%	45.0%	45.0%	86.0%
t-stats of difference in mean annual returns verse S&P 500 (p-value)	-0.2889 (0.7745)	-0.2294 (0.8201)	0.573 (0.5708)	NA

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Performance metrics

	Strategy 1	Strategy 2	Strategy 3	S&P 500
CAGR	9.80%	11.37%	22.47%	9.45%
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Performance metrics

	Strategy 3	S&P 500
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Sortino ratio	1.59	1.53
Maximum drawdown	45.0%	86.0%
t-stats of difference in mean annual returns verse S&P 500 (p- value)	0.573 (0.5708)	NA

- Provide equal comparison
- Does not reflect volatility as it assumes constant growth throughout the period

Performance metrics

	Strategy 3	S&P 500
CAGR	22.47%	9.45%
Sharpe ratio	0.87	0.34
Sortino ratio	1.59	1.53
Maximum drawdown	45.0%	86.0%
t-stats of difference in mean annual returns verse S&P 500 (p-value)	0.573 (0.5708)	NA

- Better performance in terms of excess return per unit of risk
- Better performance in terms of excess return per unit of **downside** risk.

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Performance metrics

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- Maximum cumulative percentage loss suffered during the 20-year period
- Lower drawdown -> lower volatility -> more stable return

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Performance metrics

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- p-value > 0.05
- Insufficient to reject H0 that mean annual returns are equal to that of S&P500

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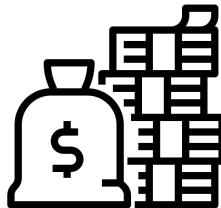
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Interpretation of Strategy 3

Signals	Selection Criteria	
	Long	Short
Market capitalization	S3: MKVALT >= 35th percentile S2: MKVALT >= 40th percentile	S3: MKVALT >= 35th percentile S2: MKVALT >= 40th percentile
Book-to-market ratio	S3: BM ratio >= 95th percentile S2: BM ratio >= 90th percentile	S3: BM ratio <= 5th percentile S2: BM ratio <= 10th percentile
F-score	S3: F-SCORE >= 9 S2: F-SCORE >= 8	S3: F-SCORE <= 2 S2: F-SCORE <= 1

* Iterative parameter tuning is used in strategy 3 to generate a list of possible values for the cut-off points for the above parameters

Interpretation of Strategy 3



Market Capitalization

Strategy 3

MKVALT \geq 35th percentile

Market capitalization cut-off reduced from 40th to 35th percentile
→ portfolio now includes smaller-cap stocks.

Theories

Small-cap stocks tend to be more volatile and generate higher return

Strategy 2

MKVALT \geq 40th percentile

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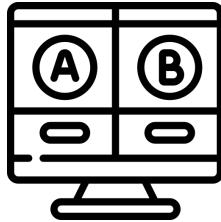
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Interpretation of Strategy 3



BM Ratio

Strategy 3

Long: BM ratio \geq 95th percentile

Short: BM ratio \leq 5th percentile

BM cut-off for longing a stock increased from 90th to 95th percentile
→ portfolio now focuses on the more undervalued stocks.

BM cut-off for shorting a stock decreased from 10th to 5th percentile
→ portfolio now includes the more overvalued stocks.

Theories

High BM stocks tend to generate higher return.
Low BM stocks tend to generate higher loss.

Strategy 2

Long: BM ratio \geq 90th percentile

Short: BM ratio \leq 10th percentile

Interpretation of Strategy 3



F-SCORE

Strategy 3

Long: F-SCORE ≥ 9

Short: S3: F-SCORE ≤ 2

Strategy 2

Long: F-SCORE ≥ 8

Short: S3: F-SCORE ≤ 1

F_SCORE cut-off for longing a stock increased from 8 to 9
→ portfolio now considers the financially strongest stocks

F_SCORE cut-off for shorting a stock increased from 1 to 2
→ portfolio now includes financially stronger stocks

Theories

Financially stronger firms tend to generate higher return.
Financially weaker firms tend to generate higher loss.



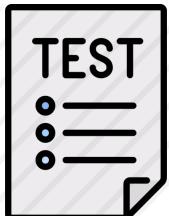
Limitations and Future Improvements



Limitations and Future Improvements



Limitation	Future Improvement
<p>Lack of portfolio weight optimization</p> <p>Equal-weighted portfolios are used in all the strategies. Hence, weight assigned to each stock in the portfolio are not optimized in terms of risk diversification.</p>	<p>Modern Portfolio Theory by Henry Markowitz</p> <p>Assigns different weight to each stock in the portfolio based on several parameters and identify a set of weights that generates the highest Sharpe ratio, thereby improving the risk-adjusted return.</p>
<p>Insignificant difference in mean annual return</p> <p>Based on the t-test result, there is insufficient evidence to reject the null hypothesis that the mean annual returns of the strategies are equal to that of S&P 500.</p>	<p>Increase Sample Size</p> <p>One possible reason may be due to the small sample size of only 20 annual returns available for the t-test. Hence, by including more years of data, it may reduce the uncertainty in the sample mean estimation.</p>



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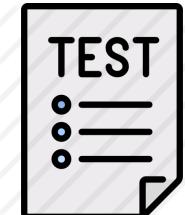
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Limitations and Future Improvements



Limitation	Future Improvement
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Signals	Selection Criteria		Limitation
	Long	Short	
Market capitalization	MKVALT >= 35 th percentile	MKVALT >= 35 th percentile	1 Lack of portfolio weight optimization
Book-to-market ratio	BM ratio >= 95 th percentile	BM Ratio <= 5 th percentile	2 Insignificant difference in mean annual return
F-score	F-SCORE >= 9	F-SCORE <= 2	



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