Fundamental, Technical, and Combined Information for Separating Winners from Losers

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Outline of Presentation

- Introduction and Motivation
- Summary of Findings
- Data and Methodology
- Empirical Results
- Summary and Future Research

Introduction

- Examine the combination of fundamental and technical information in developing investment strategy. According to Lee, Finnerty, and Wort (1990),
  - *Fundamental analysis* studies the fundamental facts of the firm affecting a stock's value.
  - *Technical analysis* concentrates on security market prices and related summary statistics of security trading.

- Based on Granger and Ramanathan (1984), Lee et al. (1986) and Lee and Cummins (1998), we propose a combined investment strategy.
  - We study whether the incorporation of firm's fundamental information proxied by the composite fundamental scores (FSCORE/GSCORE) in the momentum investment strategy improve investors' ability to further separate winners from losers.

Motivation

In the prior literature,

- Momentum strategy based on past winners and losers generate significantly positive returns in the ensuing periods (Jegadeesh and Titman (1993), Chan, Jagadeesh, and Lakonishock (1996), Rouwenhorst (1998), Chui, Titman, and Wei (2003))
  - The past trading volume has also been shown to measure the persistence and magnitude of momentum returns (Lee and Swaminathan (2000), Chan, Hameed and Tong (2000), Grinblatt and Moskowitz (2004))

- Strategy based on composite fundamental scores constructed by firm specific accounting information also generate significantly positive returns (Piotroski (2000), Mohanram (2005)).

Motivation (cont'd)

- *Bill Miller Not Dead Yet as Value Bury Quants*, April. 20, 2009, Bloomberg.com

  - *".....Quant momentum techniques may have lost 27 percent this month in the U.S., the most since 1993,.....Momentum is one factor that does not work in turnarounds..."*

  - *"Companies that Piotroski ranked highest have outperformed the lowest-rated stocks every year but two since 1994,..."*

Research Questions

- Can the combined strategy based on past returns, trading volume, and fundamental information (FSCORE/GSCORE) outperform the traditional momentum strategy?
  - Does accounting information provide additional information to investors for separating the momentum winners from losers?

- What are the risk-return characteristics of our combined strategy? Does the combined strategy generate better risk-adjusted returns than the traditional momentum strategy?

Summary of Findings

- We find that the long-short investment strategy based on past returns, trading volume, and firm's fundamental scores (FSCORE/GSCORE) produce significantly larger profits than the momentum strategy studied in prior literature.
  - Our combined strategy outperforms the strategy based on past return and trading volume on average by 1.6335% (1.6298%) monthly among high (low) book-to-market stocks.
  - Our combined strategy also generates higher information ratio than the traditional momentum strategy.

Literature Review

- Fundamental Analysis
  - Value investing (Graham and Dodd (1934))
  - Dividends discount model (Gordon (1962)).
  - Residual income valuation model (Ohlson (1995), Feltham-Ohlson (1995)).
  - Financial multiples (Ou and Penman (1989), Kaplan and Ruback (1995), Gilson, Hotchkiss, and Ruback (2000), Liu, Nissim, and Thomas (2002)).

Literature Review

- Composite financial statement analysis
  - Piotroski (2000) examined the financial characteristics of high book-to-market stocks (value stocks): *FSCORE.*
  - Mohanram (2005) examined the financial characteristics of low book-to-market stocks (growth stocks): *GSCORE*.
  - Long-short strategy based on these scores have been shown to generate positive returns up to two years after the portfolio formation date.

Financial Statement Analysis Scores

- Piotroski (2000): FSCORE for high BM stocks.
  - ROA, AROA, CFO, Accrual, DMargin, DTurn, DLever, DLIQUID, EQOFFER.
  - FSCORE ranges from 0 to 9.

$$FSCORE = ROA + AROA + CFO + Accrual + DMargin + DTurn + DLever + DLIQUID + EQOFFER$$

- Mohanram (2005): GSCORE for low BM stocks.
  - ROA_I, CFO_I, Accrual, σ_{NI}, σ_{SG}, RDINT, ADINT., CAPINT.
  - GSCORE ranges from 0 to 8.

$$GSCORE = ROA_I + CFO_I + Acrrual + \sigma_{NI} + \sigma_{SG} + RDINT + ADINT + CAPINT$$

Literature Review

- Momentum trading strategy
  - Jegadeesh and Titman (1993) found that the long-short trading strategy with long position in past winners and short position in losers generate positive returns in the ensuing periods.
    - Int'l evidence have been documented by Rouwenhorst (1998), Chui, Titman, and Wei (2000).
    - Chan, Jagadeesh, and Lakonishock (1996), Chordia and Shivakumar (2002) examined both price and earnings momentum.
    - Lesmond, Schill, and Zhou (2004), Korajczyk and Sadka (2004) examined whether momentum profits are robust to transaction costs.

Literature Review

- Proposed hypotheses of why momentum arises.
  - Barberis, Shleifer, and Vishny (1998): Conservatism leads to *underreaction* to news.
  - Daniel, Hirshleifer, and Subrahmanyam (1998): *Overconfidence* and *self-attribution* of the informed investors.
  - Hong and Stein (1999): *Asymmetric information.* Delayed revelation of the news, or gradual diffusion of the news, from the informed investors leads to underreaction by the uninformed.

Literature Review

- Wu (2007): Momentum arises because of the simultaneous presence of *asymmetric information* between the informed and uninformed as well as the *fixed transaction cost* faced by the uninformed.
  - When the informed want to realize the profits from their *long* position, uninformed are not in the market to *buy* → This leads to *negative* price adjustment and thus subsequent *winner momentum*.
  - When the informed want to realize the profits from their *short* position, uninformed are not in the market to *sell* → This leads to *positive* price adjustment and thus subsequent *loser momentum*.

Literature Review

- Measure for the degree of asymmetric information: BOS ratio (Liquidity Buy/Liquidity Sell)
  - Empirical proxy for BOS:

$$BOS = cov(r_t^i, \pi_t^i) \text{ where } \pi_t^i = \frac{|V_t^i|}{E[|V_t|]}$$

- Winners (losers) with low (high) BOS are subject to larger degree of asymmetric info and thus more pronounced momentum effect is expected.

Sample Selection

- All non-financial firms listed on NYSE and AMEX with sufficient monthly return and volume data on CRSP, and annual accounting data on Compustat from January 1982 to December 2007.
  - Nasdaq stocks excluded because of the double counting issues.
  - No foreign firms, closed-end fund, REIT, ADR.
  - Firms with price less than $1 and negative B/M ratio at the portfolio formation date are excluded.

Portfolios Construction

- At the end of each month, the top (bottom) 20% of the BM ratio are selected as the value (growth) stocks.
- Stocks are sorted sequentially by cumulative returns in the past twelve months, the BOS ratio, and the fundamental scores.
- We examine the performance of the investment strategy involving the extreme portfolios, i.e. portfolios (Q_{M5},Q_{B5},Q_{F1}) and (Q_{M1},Q_{B5},Q_{F5}), for holding periods of one, three, and six months after the portfolio formation date.

Correlation Analysis among Returns, Volume, Signals, and FSCORE for Value Stocks

	Ret_1	Ret_2	FSCORE	BOS	Cum.Ret.	F1	F2	F3	F4	F5	F6	F7	F8	F9
Ret_1	1	0.521	0.171	0.003	0.423	0.084	0.031	0.102	0.049	0.042	0.052	0.051	0.025	0.015
Ret_2		1	0.184	-0.022	0.397	0.091	0.029	0.114	0.061	0.037	0.029	0.054	0.031	0.038
FSCORE			1	0.067	0.005	0.471	0.549	0.512	0.341	0.416	0.371	0.410	0.347	0.297
BOS Ratio				1	-0.007	0.06	0.047	0.106	0.068	0.012	0.024	0.081	0.087	0.034
Cum. Ret.					1	0.012	0.007	0.046	0.071	0.004	-0.002	0.102	0.031	0.054
F1:$ROA \geq 0$						1	0.241	0.357	-0.019	0.687	-0.017	0.141	0.114	-0.051
F2:$AROA \geq 0$							1	0.125	-0.023	0.411	0.009	0.128	0.124	0.031
F3:$CFO \geq 0$								1	0.514	0.061	0.039	0.087	0.141	-0.027
F4:$Accrual \leq 0$									1	-0.002	0.059	0.014	0.067	-0.013
F5:$DMargin \geq 0$										1	0.001	0.067	0.079	0.011
F6:$DTurn \geq 0$											1	0.080	0.049	0.029
F7:$DLever \leq 0$												1	-0.004	-0.019
F8:$DLIQUD \geq 0$													1	-0.021
F9:$EQOFFER \geq 0$														1

Correlation Analysis among Returns, Volume, Signals, and GSCORE for Growth Stocks

	Ret_1	Ret_2	GSCORE	BOS	Cum.Ret.	G1	G2	G3	G4	G5	G6	G7	G8
Ret_1	1	0.578	0.114	0.011	0.452	0.048	0.051	0.028	0.071	0.059	0.041	0.021	0.023
Ret_2		1	0.123	-0.007	0.411	0.051	0.063	0.034	0.081	0.063	0.051	0.029	0.034
GSCORE			1	0.073	0.008	0.601	0.712	0.201	0.541	0.611	0.168	0.513	0.351
BOS Ratio				1	-0.011	0.088	0.064	0.014	0.121	0.097	0.074	0.011	0.007
Cum.Ret.					1	0.004	0.016	0.007	0.013	0.024	0.031	0.007	-0.002
G1:$ROA \geq Ind_M$						1	0.554	-0.189	0.315	0.310	-0.135	0.098	0.064
G2:$CFO \geq Ind_M$							1	0.061	0.341	0.321	-0.114	0.078	0.063
G3:$Accrual \leq 0$								1	0.113	0.051	-0.071	0.009	0.034
G4:$\sigma_{NI} \leq Ind_M$									1	0.501	-0.154	0.056	0.027
G5:$\sigma_{SG} \leq Ind_M$										1	-0.112	0.083	0.071
G6:$RDINT \geq Ind_M$											1	0.103	-0.027
G7:$ADINT \geq Ind_M$												1	0.009
G8:$CAPINT \geq Ind_M$													1

Returns Calculations

- Monthly excess returns

$$r_{i,excess} = (r_i - r_f)$$

where

r_i is the monthly long-short portfolio returns

r_f is the monthly return on the 3-month T-Bill

- Fama-French 3 Factors Model monthly adjusted returns, i.e. the estimated *intercept* coefficient α_i from the following regression:

$$(r_i - r_f) = \alpha_i + \beta_i (r_m - r_f) + \phi_i SMB + \varphi_i HML + e_i$$

where

r_m is the value-weighted return on the NYSE/AMEX/Nasdaq market index

SMB is the Fama-French small firm factor

HML is the Fama-French book-to-market factor

Traditional Momentum Strategy

Table 4. Returns to Strategy Based On Past Returns (1982-2007)

Panel A: Value Stocks

Average Monthly Excess Returns (%)

	Q_{M1}	Q_{M2}	Q_{M3}	Q_{M4}	Q_{M5}	Q_{M5}-Q_{M1}
1-Month(K=1)	0.3770	0.4851	0.5225	0.7244	0.9428	0.4658
	2.32	2.58	2.65	2.76	2.91	2.66
3-Month(K=3)	0.3219	0.3728	0.4836	0.5308	0.8997	0.5778
	2.21	2.33	2.37	2.52	2.88	2.69
6-Month(K=6)	0.2451	0.3668	0.4887	0.5560	0.7356	0.4905
	1.95	2.25	2.55	2.66	2.77	2.59

Fama-French 3-Factor Model Monthly Adj. Returns (%)

	Q_{M1}	Q_{M2}	Q_{M3}	Q_{M4}	Q_{M5}	Q_{M5}-Q_{M1}
1-Month(K=1)	0.0791	0.2685	0.3724	0.5072	0.7939	0.7184
	1.42	1.88	1.93	2.53	2.82	2.78
3-Month(K=3)	0.0066	0.2271	0.3886	0.4853	0.7737	0.7670
	0.25	1.70	1.92	2.08	2.77	2.75
6-Month(K=6)	-0.0187	0.2124	0.3767	0.4093	0.6487	0.6675
	-0.53	1.71	1.90	1.95	2.69	2.65

Traditional Momentum Strategy

Panel B: Growth Stocks

Average Monthly Excess Returns (%)

	Q_{M1}	Q_{M2}	Q_{M3}	Q_{M4}	Q_{M5}	Q_{M5}-Q_{M1}
1-Month(K=1)	0.0331	0.1420	0.3371	0.6702	0.9434	0.9103
	1.25	1.52	1.78	2.28	2.85	2.80
3-Month(K=3)	-0.0196	0.5218	0.7565	0.8673	0.9580	0.9776
	-1.15	2.15	2.37	2.53	2.91	2.98
6-Month(K=6)	0.1519	0.1784	0.2987	0.6759	0.9176	0.7656
	1.61	1.66	1.70	2.22	2.81	2.41

Fama-French 3-factor Model Monthly Adj. Returns (%)

	Q_{M1}	Q_{M2}	Q_{M3}	Q_{M4}	Q_{M5}	Q_{M5}-Q_{M1}
1-Month(K=1)	-0.8206	-0.2347	0.2001	0.3349	0.4602	1.2808
	-2.41	1.62	1.53	1.80	1.91	3.21
3-Month(K=3)	-0.8471	-0.1418	0.1906	0.3296	0.4920	1.3290
	-2.48	-1.48	1.63	1.75	2.02	3.41
6-Month(K=6)	-0.6608	-0.2037	0.2379	0.3862	0.4655	1.1263
	-2.20	-1.50	-1.65	1.83	1.97	3.02

Returns to Strategy based on Past Returns and BOS Ratio

	Panel A: Value Stocks						Panel B: Growth Stocks					
1-Month Average Excess Return (%)												
	Q_{B1}	Q_{B2}	Q_{B3}	Q_{B4}	Q_{B5}	$(Q_{B5}$-$Q_{B1})$	Q_{B1}	Q_{B2}	Q_{B3}	Q_{B4}	Q_{B5}	$(Q_{B5}$-$Q_{B1})$
Q_{M5} (Loser)	-0.0987	-0.1354	-0.1641	-0.1878	-0.2184	-0.1197	-0.0745	-0.0898	-0.1077	-0.1151	-0.3471	-0.2726
	-1.51	-1.74	-1.88	-1.93	-1.85	-1.64	-1.42	-1.50	-1.59	-1.65	-2.02	-1.98
Q_{M1} (Winner)	0.4412	0.5412	0.6984	0.7453	0.8891	0.4479	0.5314	0.6125	0.6544	0.7521	1.1282	0.5968
	2.42	2.59	2.71	2.87	2.95	2.51	2.51	2.68	2.70	2.84	3.33	2.65
(Q_{M1},Q_{B5})					1.1075						1.5753	
$-(Q_{M5},Q_{B5})$					3.01						3.52	
$\Delta_{BOS-MOM}$					0.6412						0.6650	
					2.63						2.72	

3-Month Average Excess Return (%)												
	Q_{B1}	Q_{B2}	Q_{B3}	Q_{B4}	Q_{B5}	$(Q_{B5}$-$Q_{B1})$	Q_{B1}	Q_{B2}	Q_{B3}	Q_{B4}	Q_{B5}	$(Q_{B5}$-$Q_{B1})$
Q_{M5} (Loser)	-0.0545	-0.0741	-0.0788	-0.0874	-0.1037	-0.0492	-0.0121	-0.0154	-0.0823	-0.1215	-0.3254	-0.3133
	-1.22	-1.28	-1.35	-1.42	-1.58	-1.14	-1.08	-1.10	-1.38	-1.63	-1.98	-2.05
Q_{M1} (Winner)	0.7415	0.8121	0.8454	0.9542	0.9972	0.2557	0.6654	0.7395	0.8451	0.9874	1.3387	0.6733
	2.71	2.80	2.85	2.92	2.99	2.44	2.61	2.81	2.99	3.02	3.14	2.64
(Q_{M1},Q_{B5})					1.1009						1.6641	
$-(Q_{M5},Q_{B5})$					2.90						3.31	
$\Delta_{BOS-MOM}$					0.5231						0.6865	
					2.61						2.75	

Returns to Strategy based on Past Returns and BOS Ratio (Cont'd)

	Panel A: Value Stocks						Panel B: Growth Stocks					
1-Month FF3 Adj. Return (%)												
	Q_{B1}	Q_{B2}	Q_{B3}	Q_{B4}	Q_{B5}	$(Q_{B5}-Q_{B1})$	Q_{B1}	Q_{B2}	Q_{B3}	Q_{B4}	Q_{B5}	$(Q_{B5}-Q_{B1})$
Q_{M5} (Loser)	0.0015	-0.1535	-0.2987	-0.3151	-0.3973	-0.3988	-0.1054	-0.1214	-0.1987	-0.1815	-0.4252	-0.3198
	0.56	-1.85	-2.01	-2.05	-2.09	-2.11	-1.47	-1.61	-1.70	-1.68	-2.21	-2.03
Q_{M1} (Winner)	0.7028	0.6955	1.1392	1.2275	1.3344	0.6316	0.1137	0.1639	0.2239	0.5862	1.4208	1.3071
	2.51	2.48	2.95	3.02	3.11	2.45	1.58	1.65	1.81	2.21	3.17	3.10
(Q_{M1},Q_{B5})					1.7317						1.8460	
$-(Q_{M5},Q_{B5})$					3.55						3.67	
$\Delta_{BOS-MOM}$					1.0133						0.5652	
					2.81						2.66	
3-Month FF3 Adj. Return (%)												
	Q_{B1}	Q_{B2}	Q_{B3}	Q_{B4}	Q_{B5}	$(Q_{B5}-Q_{B1})$	Q_{B1}	Q_{B2}	Q_{B3}	Q_{B4}	Q_{B5}	$(Q_{B5}-Q_{B1})$
Q_{M5} (Loser)	-0.1115	-0.1298	-0.1357	-0.1484	-0.1658	-0.0543	-0.3231	-0.3545	-0.4122	-0.4981	-0.8534	-0.5383
	-1.51	-1.52	-1.57	-1.60	-1.65	1.02	-2.01	-2.05	-2.11	-2.15	-2.67	-2.29
Q_{M1} (Winner)	0.6559	0.6542	1.1111	1.1478	1.4284	0.7725	0.1831	0.2032	0.3952	0.5617	1.0058	0.7337
	2.32	2.30	2.91	2.94	3.23	2.55	1.81	1.85	2.06	2.22	2.75	2.52
(Q_{M1},Q_{B5})					1.5942						1.8592	
$-(Q_{M5},Q_{B5})$					3.79						3.31	
$\Delta_{BOS-MOM}$					0.8272						0.5302	
					2.57						2.65	

Combined Strategy - FSCORE

Panel A: Monthly Average Excess Returns (%)

1-Month Average Excess Return (%)

	Q_{F1}	Q_{F2}	Q_{F3}	Q_{F4}	Q_{F5}	$(Q_{F5}\text{-}Q_{F1})$
(Q_{M5},Q_{B5})	-0.6941	-0.5512	-0.3245	0.1051	0.5184	1.2125
	-2.22	-2.08	-1.74	1.45	2.33	2.95
(Q_{M1},Q_{B5})	0.0315	0.1541	0.4314	0.8454	1.0876	1.2561
	0.26	1.75	1.92	2.62	2.71	3.02
(Q_{M1},Q_{B5},Q_{F5})					1.7817	
$-(Q_{M5},Q_{B5},Q_{F1})$					3.31	
Δ_{CS-BOS}					0.6742	
					2.71	

3-Month Average Excess Return (%)

	Q_{F1}	Q_{F2}	Q_{F3}	Q_{F4}	Q_{F5}	$(Q_{F5}\text{-}Q_{F1})$
(Q_{M5},Q_{B5})	-2.1933	-2.1107	-0.9413	-0.8026	0.0778	2.2711
	-4.02	-2.84	-2.61	-2.51	1.61	4.52
(Q_{M1},Q_{B5})	-0.3498	0.1209	0.2742	0.6157	1.1665	1.5163
	-1.88	-0.82	-1.74	2.12	2.76	3.11
(Q_{M1},Q_{B5},Q_{F5})					3.3598	
$-(Q_{M5},Q_{B5},Q_{F1})$					5.54	
Δ_{CS-BOS}					2.2589	
					4.43	

6-Month Average Excess Return (%)

	Q_{F1}	Q_{F2}	Q_{F3}	Q_{F4}	Q_{F5}	$(Q_{F5}\text{-}Q_{F1})$
(Q_{M5},Q_{B5})	-2.0617	-1.0480	-0.6003	-0.2034	0.2355	2.2971
	-3.71	-2.42	-2.08	-1.94	1.93	4.55
(Q_{M1},Q_{B5})	0.1026	0.3453	0.4125	0.6279	0.8968	0.7942
	1.71	1.91	2.02	2.17	2.41	2.35
(Q_{M1},Q_{B5},Q_{F5})					2.9584	
$-(Q_{M5},Q_{B5},Q_{F1})$					4.87	
Δ_{CS-BOS}					1.9675	
					3.64	

Panel B: Fama-French Three Factors Model Adjusted Returns (%)

1-Month FF3 Adj. Return (%)

	Q_{F1}	Q_{F2}	Q_{F3}	Q_{F4}	Q_{F5}	$(Q_{F5}$-$Q_{F1})$
(Q_{M5},Q_{B5})	-0.8502	-0.5855	-0.0695	-0.0474	0.4323	1.2825
	-2.32	-3.05	-2.05	-2.18	2.88	2.35
(Q_{M1},Q_{B5})	0.2194	0.7539	0.8820	1.1719	1.2928	1.0735
	-2.63	-1.45	-0.47	2.28	2.49	2.65
(Q_{M1},Q_{B5},Q_{F5})					2.1431	
$-(Q_{M5},Q_{B5},Q_{F1})$					2.73	
Δ_{CS-BOS}					0.4114	
					2.41	

3-Month FF3 Adj. Return (%)

	Q_{F1}	Q_{F2}	Q_{F3}	Q_{F4}	Q_{F5}	$(Q_{F5}$-$Q_{F1})$
(Q_{M5},Q_{B5})	-2.9846	-1.8120	-1.1596	-0.5820	-0.0275	2.9571
	-4.75	-2.90	-2.02	-1.17	-1.05	4.23
(Q_{M1},Q_{B5})	-1.4931	-1.3754	-0.0954	0.6587	0.8885	2.3817
	-2.76	-2.48	-0.16	1.62	1.92	3.60
(Q_{M1},Q_{B5},Q_{F5})					3.8732	
$-(Q_{M5},Q_{B5},Q_{F1})$					5.01	
Δ_{CS-BOS}					2.2790	
					3.51	

6-Month FF3 Adj. Return (%)

	Q_{F1}	Q_{F2}	Q_{F3}	Q_{F4}	Q_{F5}	$(Q_{F5}$-$Q_{F1})$
(Q_{M5},Q_{B5})	-1.7089	-0.8120	-0.1596	-0.0582	0.1682	1.8771
	-5.04	2.89	-2.02	-1.16	0.63	4.64
(Q_{M1},Q_{B5})	0.6712	0.6246	0.9046	1.6587	1.9100	1.2388
	-1.57	-3.08	-0.16	1.62	2.50	2.38
(Q_{M1},Q_{B5},Q_{F5})					3.6189	
$-(Q_{M5},Q_{B5},Q_{F1})$					5.66	
Δ_{CS-BOS}					2.1991	
					3.34	

Combined Strategy - GSCORE

Panel A: Monthly Average Excess Returns (%)

1-Month Average Excess Return (%)

	Q_{G1}	Q_{G2}	Q_{G3}	Q_{G4}	Q_{G5}	$(Q_{G5}$-$Q_{G1})$
(Q_{M5},Q_{B5})	-1.2545	-1.1572	-1.0315	-0.4648	0.2357	1.4902
	-2.61	-2.51	-2.42	-1.84	1.67	2.82
(Q_{M1},Q_{B5})	0.4123	0.7263	1.4065	1.4162	2.0510	1.6387
	1.82	2.21	2.61	2.66	3.66	2.95
(Q_{M1},Q_{B5},Q_{G5})					3.3055	
$-(Q_{M5},Q_{B5},Q_{G1})$					5.44	
Δ_{CS-BOS}					1.7302	
					3.12	

3-Month Average Excess Return (%)

	Q_{G1}	Q_{G2}	Q_{G3}	Q_{G4}	Q_{G5}	$(Q_{G5}$-$Q_{G1})$
(Q_{M5},Q_{B5})	-1.0906	-0.8734	-0.5851	-0.2716	0.1133	1.2039
	-2.41	-2.33	-2.01	-1.61	1.18	2.77
(Q_{M1},Q_{B5})	0.0715	0.7883	0.6844	0.7689	1.9387	1.8671
	1.12	2.31	2.25	2.32	3.54	3.21
(Q_{M1},Q_{B5},Q_{G5})					3.0293	
$-(Q_{M5},Q_{B5},Q_{G1})$					4.98	
Δ_{CS-BOS}					1.3652	
					2.78	

6-Month Average Excess Return (%)

	Q_{G1}	Q_{G2}	Q_{G3}	Q_{G4}	Q_{G5}	$(Q_{G5}$-$Q_{G1})$
(Q_{M5},Q_{B5})	-0.9180	-0.2549	-0.4946	-0.3644	0.1193	1.0373
	-2.34	-1.51	-1.81	-1.75	1.23	2.62
(Q_{M1},Q_{B5})	0.4166	0.4748	0.7137	0.9755	1.4851	1.0685
	1.99	2.25	2.45	2.80	3.16	2.90
(Q_{M1},Q_{B5},Q_{G5})					2.4031	
$-(Q_{M5},Q_{B5},Q_{G1})$					3.91	
Δ_{CS-BOS}					0.9567	
					2.88	

Panel B: Fama-French Three Factors Model Adjusted Returns (%)

1-Month FF3 Adj. Return (%)

	Q_{G1}	Q_{G2}	Q_{G3}	Q_{G4}	Q_{G5}	$(Q_{G5}-Q_{G1})$
(Q_{M5},Q_{B5})	-2.7527	-2.4969	-1.6459	-0.6184	0.0935	2.8462
	-4.52	-4.34	-3.31	-2.10	1.02	4.61
(Q_{M1},Q_{B5})	-0.1459	0.2641	0.4241	0.6948	0.9571	1.1030
	-1.31	1.52	1.85	2.18	2.53	2.81
(Q_{M1},Q_{B5},Q_{G5})					3.7097	
$-(Q_{M5},Q_{B5},Q_{G1})$					5.55	
Δ_{CS-BOS}					1.8637	
					4.23	

3-Month FF3 Adj. Return (%)

	Q_{G1}	Q_{G2}	Q_{G3}	Q_{G4}	Q_{G5}	$(Q_{G5}-Q_{G1})$
(Q_{M5},Q_{B5})	-2.2433	-1.5607	-0.7359	-0.3886	-0.1034	2.1399
	-4.15	-3.23	-2.22	-1.75	-1.20	4.01
(Q_{M1},Q_{B5})	-0.4804	-0.5952	-0.2692	0.1128	0.9498	1.4302
	-1.94	-2.02	-1.58	1.33	2.43	3.15
(Q_{M1},Q_{B5},Q_{G5})					3.1931	
$-(Q_{M5},Q_{B5},Q_{G1})$					5.04	
Δ_{CS-BOS}					1.3339	
					3.10	

6-Month FF3 Adj. Return (%)

	Q_{G1}	Q_{G2}	Q_{G3}	Q_{G4}	Q_{G5}	$(Q_{G5}-Q_{G1})$
(Q_{M5},Q_{B5})	-1.9265	-1.4594	-0.9450	-0.5976	-0.0580	1.8686
	-3.71	-3.15	-2.44	-2.05	-1.11	3.69
(Q_{M1},Q_{B5})	-0.1530	-0.0803	0.0245	0.4207	0.7552	0.7082
	-1.40	-1.21	1.09	1.92	2.27	2.47
(Q_{M1},Q_{B5},Q_{G5})					2.5817	
$-(Q_{M5},Q_{B5},Q_{G1})$					4.15	
Δ_{CS-BOS}					0.8175	
					2.77	

Risk-Return Characteristics of Combined Strategy

- We calculate the *Information Ratio* of different strategies.

$$IR = \frac{(r_i - r_m)}{\sigma_{(r_i - r_m)}}$$

where *active return* (r_i-r_m) is the difference between the return on the strategies and the return on the NYSE/AMEX/Nasdaq value-weighted return, and *tracking error* is the S.D. of the active return.

- We also calculate the correlation between the returns on *fundamental strategy* and the *momentum strategy*.
  - Negative correlation indicate the diversification effect achieved by combining different information sets.

Risk-Return Characteristics of Combined Strategy

Panel A: Value Stocks												
	MOM			*BOS*			*CS*			Corr(FSCORE,MOM)		
	H-L	H-M	L-M	H-L	H-M	L-M	H-L	H-M	L-M	H-L	H-M	L-M
		long side	*short side*		*long side*	*short side*		*long side*	*short side*		*long side*	*short side*
Excess $Return_{1-month}$ (%)	0.4658	0.4203	-0.0455	1.1075	0.7923	-0.3152	1.7817	1.4193	-0.3624	-0.29	-0.30	-0.14
t-stat	2.61	2.78	-1.75	2.75	2.63	-2.23	2.74	2.77	-2.61			
Information Ratio	0.37	0.51	-0.24	0.51	0.54	-0.34	0.57	0.49	-0.33			
% Contribution of Long/Short Sides		90.23%	9.76%		71.54%	20.76%		79.66%	20.39%			
Excess $Return_{3-month}$ (%)	0.5778	0.5161	-0.1073	1.1009	0.8297	-0.2711	3.3598	2.3757	-0.9840	-0.31	-0.21	-0.18
t-stat	2.69	2.78	-1.54	2.81	3.04	-1.74	4.54	4.22	-2.41			
Information Ratio	0.41	0.39	-0.29	0.47	0.46	-0.36	0.66	0.47	-0.42			
% Contribution of Long/Short Sides		89.32%	10.68%		75.37%	24.63%		70.71%	29.29%			
Excess $Return_{6-month}$ (%)	0.4905	0.3469	-0.1436	0.9909	0.7673	-0.2237	2.9584	2.2634	-0.6949	-0.34	-0.19	-0.20
t-stat	2.71	2.84	-1.81	2.66	2.76	-2.41	2.94	2.71	-2.62			
Information Ratio	0.38	0.34	-0.19	0.43	0.39	-0.34	0.60	0.63	-0.42			
% Contribution of Long/Short Sides		70.72%	29.28%		77.43%	22.57%		76.51%	23.49%			

Risk-Return Characteristics of Combined Strategy

Panel B: Growth Stocks

	MOM			*BOS*			*CS*			Corr(GSCORE,MOM)		
	H-L	H-M	L-M	H-L	H-M	L-M	H-L	H-M	L-M	H-L	H-M	L-M
		long side	*short side*		*long side*	*short side*		*long side*	*short side*		*long side*	*short side*
Excess $\text{Return}_{1-month}$ (%)	0.9103	0.7063	-0.2040	1.5753	1.3669	-0.2084	3.3055	2.5300	-0.7755	-0.37	-0.29	-0.17
t-stat	2.81	2.74	-2.21	2.68	2.71	-1.56	2.83	2.78	-2.35			
Information Ratio	0.39	0.41	-0.29	0.44	0.48	-0.25	0.67	0.64	-0.43			
% Contribution of Long/Short Sides		77.59%	22.41%		86.77%	13.23%		76.54%	23.46%			
Excess $\text{Return}_{3-month}$ (%)	0.9776	0.7015	-0.2761	1.6641	1.4082	-0.2559	3.0293	2.2556	-0.7737	-0.33	-0.25	-0.14
t-stat	3.32	2.46	-1.87	2.58	2.64	-1.51	2.94	3.03	-2.02			
Information Ratio	0.43	0.47	-0.35	0.48	0.44	-0.37	0.63	0.48	-0.39			
% Contribution of Long/Short Sides		68.58%	31.42%		84.62%	15.38%		74.46%	25.54%			
Excess $\text{Return}_{6-month}$ (%)	0.7656	0.6189	-0.1468	1.4464	1.1649	-0.2814	2.4031	1.9107	-0.4924	-0.26	-0.31	-0.22
t-stat	2.77	2.69	-1.86	2.62	2.71	-1.84	2.71	2.80	-2.54			
Information Ratio	0.31	0.33	-0.16	0.41	0.48	-0.21	0.58	0.60	-0.41			
% Contribution of Long/Short Sides		80.84%	19.16%		80.54%	19.46%		79.51%	20.49%			

Summary

- We find that the fundamental information (FSCORE/GSCORE) help investors to further identify momentum winners and losers.
  - Our combined investment strategy outperforms traditional momentum strategy and generates larger information ratio across different holding periods.

- Our study contributes to the momentum literature as well as the accounting-based trading strategies literature. It also provides different performance metrics to the quantitative investment community.