Signal Weighting Schemes in Portfolio Allocation

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You have found 25 Alpha Sources!
Now what?
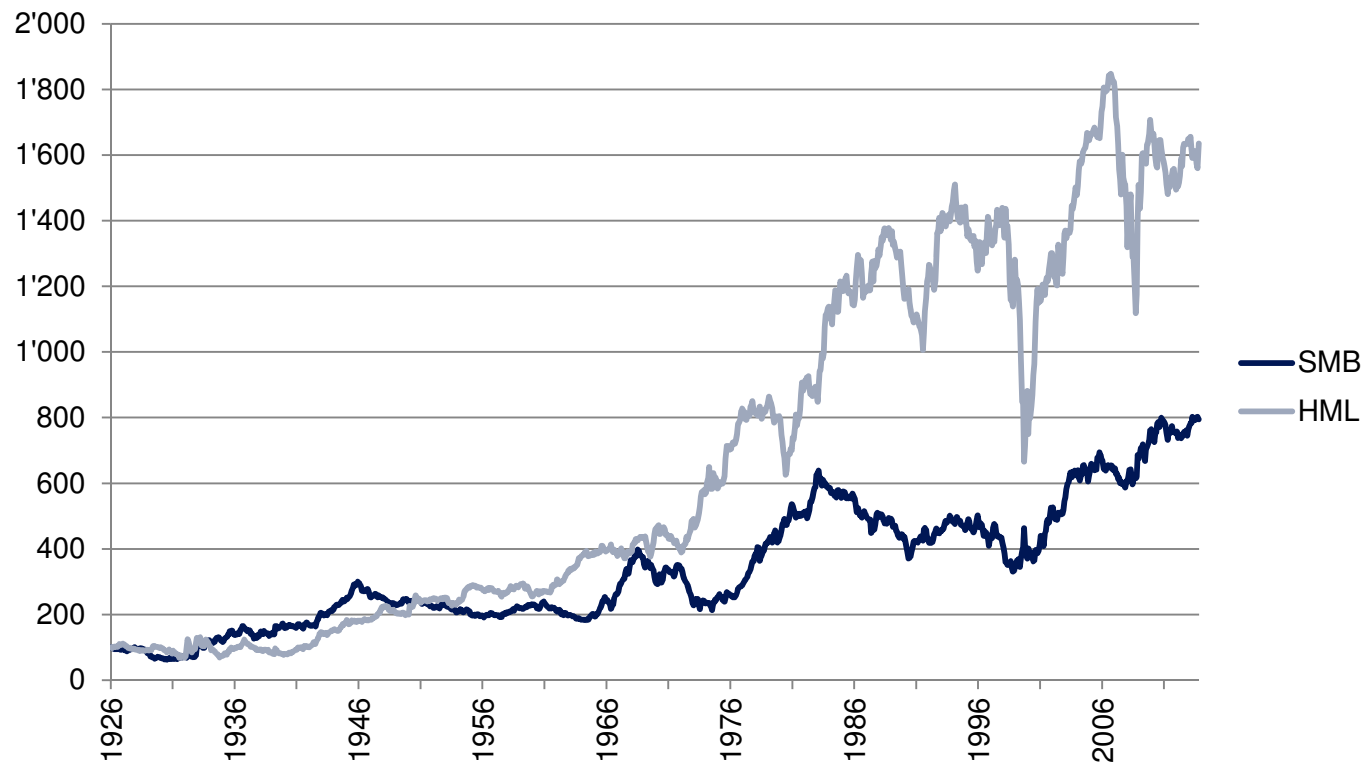
How to combine signals to generate a single return forecast?

Your signals have different properties

	Idiosyncratic Risk	Efficacy	Signal Risk	Information Horizon
Signal	**Standard Deviation**	**Alpha**	**Cross-Correlations**	**Auto-Correlation**
HML	12.69%	4.04%	0.116	0.188
SMB	11.02%	2.99%	0.116	0.072

Different methods have been developed to account for these effects

	Idiosyncratic Risk	Efficacy	Signal Risk	Information Horizon
1 / J	✓			
Fama-MacBeth		✓		
OLS (Bayesian)	✓	✓		
Markowitz	✓	✓	✓	
Min. Variance	✓		✓	
Grinold (2010)	✓	✓	✓	✓
Qian et al. (2007)	✓	✓	✓	✓

First Test: Simulated Data
Results as expected

- Generate four scenarios of data

  - Each scenario adds another level of complexity

  - Methodology by MacKinlay & Pastor (2000) and Gerard et al (2012)

  - Four signals, 500 stocks, 250 months, 20 iterations

Average Sharpe Ratios

Scenarios	Idiosyncratic Risk	& Efficacy	& Signal Risk	& Information Horizon
	1	**2**	**3**	**4**
1/J	0.33	0.38	0.22	0.24
FM	0.28	0.43	0.22	0.23
OLS	0.28	0.42	0.21	0.27
MV	0.27	0.42	0.29	0.31
MIN	0.33	0.38	0.19	0.21
Gri	0.27	0.42	0.23	0.31
QHS	0.26	0.34	0.27	0.33

Now for the real world
16 signals, 20k companies, 1.5m firm-months

Signal	Direction	N	Avg IC (%)	St Dev IC	Auto Corr
β	Ascending	263	0.12	14.65	0.12
Size	Descending	313	-2.61	4.72	0.14
BM	Ascending	313	1.18	9.83	0.20
Momentum	Ascending	306	2.08	12.05	0.08
SUE	Ascending	241	1.15	4.49	0.12
DY	Ascending	313	0.24	10.09	0.10
Illiquidity	Ascending	278	0.98	4.32	0.06
Leverage	Ascending	313	-0.82	6.58	0.08
Revisions	Ascending	311	0.60	7.01	0.17
Stock issues	Descending	313	-0.02	5.73	0.02
Accruals	Descending	313	-0.81	6.27	0.05
Asset growth	Descending	313	0.03	7.23	0.10
Capex growth	Descending	313	-0.40	6.03	0.06
ROE	Ascending	313	1.00	7.54	0.21
RV	Descending	263	2.54	12.51	0.13
Option skew	Descending	97	-1.51	7.39	0.04

Testing methodology efficacy

Stocks
- Returns
- Standardized Signals

Signal Weighting Methodology

Signal Weights

Signal Weight x Stand. Signal

Expected Returns

Sorted Quintile Portfolios

Returns of Methodology

More complex methods perform better for large universes

Data set	1/J	fm	bms	mv	min	gri	qhs
Full sample	0.2070	0.3610	0.1797	0.4637	0.0238	0.2066	0.5659
	-	(0.11)	(0.71)	(0.00)	(0.05)	(0.01)	(0.00)
01/1987 - 03/2000	0.0676	0.4782	-0.0234	0.3799	-0.3395	0.3381	0.4792
	-	(0.01)	(0.43)	(0.03)	(0.01)	(0.01)	(0.00)
04/2000 - 10/2007	0.3504	0.4246	0.3064	0.7609	0.3305	0.1052	0.7122
	-	(0.63)	(0.63)	(0.00)	(0.87)	(0.45)	(0.01)
11/2007 - 02/2013	0.1675	0.2731	0.3602	0.2184	0.1650	0.1597	0.5323
	-	(0.97)	(0.25)	(0.71)	(0.97)	(0.31)	(0.03)
Europe	0.3722	0.3008	0.2345	0.4123	0.0167	0.1436	0.4826
	-	(0.41)	(0.05)	(0.62)	(0.00)	(0.10)	(0.21)
North America	0.1090	0.3165	0.1860	0.5345	-0.0882	0.2417	0.6124
	-	(0.06)	(0.06)	(0.00)	(0.03)	(0.00)	(0.00)
Japan	0.3198	0.4016	0.3325	0.4611	0.0281	0.1700	0.4974
	-	(0.31)	(0.76)	(0.05)	(0.00)	(0.05)	(0.03)
Asia ex Japan	0.3823	0.2902	0.2142	0.2184	0.2002	0.0747	0.3547
	-	(0.29)	(0.04)	(0.03)	(0.04)	(0.39)	(0.67)

Monthly out-of-sample Sharpe Ratios of equally weighted long-short portfolios
(p-values of the difference to 1/J benchmark)

But as sample gets smaller, complexity starts to cost

Data set	1/J	fm	bms	mv	min	gri	qhs
Energy	0.0786	0.2078	0.0771	0.3089	0.1481	0.1480	0.1464
	-	(0.10)	(0.99)	(0.01)	(0.40)	(0.07)	(0.48)
Materials	0.1001	0.2475	0.2344	0.1423	0.0412	0.1666	0.2746
	-	(0.17)	(0.18)	(0.55)	(0.48)	(0.04)	(0.04)
Industrials	0.3264	0.3591	0.2299	0.4195	0.0688	0.2091	0.3553
	-	(0.60)	(0.25)	(0.21)	(0.00)	(0.01)	(0.75)
Consumer Discretionary	0.2719	0.3255	0.2239	0.3828	0.0000	0.2688	0.3381
	-	(0.49)	(0.54)	(0.20)	(0.00)	(0.00)	(0.45)
Consumer Staples	0.1941	0.3366	0.2692	0.3400	0.1450	0.1595	0.4470
	-	(0.09)	(0.34)	(0.07)	(0.58)	(0.06)	(0.00)
Health Care	0.1076	0.2865	0.1842	0.2897	0.1994	0.2070	0.2897
	-	(0.10)	(0.35)	(0.03)	(0.32)	(0.01)	(0.04)
Banks	0.3993	0.3402	0.1620	0.2883	0.0025	0.1159	0.2347
	-	(0.33)	(0.01)	(0.19)	(0.00)	(0.15)	(0.04)
Diversified Financials	0.2519	0.1448	0.1876	0.2695	-0.0098	0.1264	0.0712
	-	(0.12)	(0.48)	(0.87)	(0.01)	(0.12)	(0.02)
Insurance	0.3066	0.2211	0.1217	0.1641	0.0186	0.0769	0.2581
	-	(0.28)	(0.05)	(0.10)	(0.00)	(0.36)	(0.54)
Real Estate	0.2544	0.1557	0.1479	0.1848	0.0800	0.0156	0.1950
	-	(0.19)	(0.19)	(0.39)	(0.04)	(0.78)	(0.40)
IT	0.0641	0.3439	0.1227	0.3879	-0.0660	0.1835	0.4116
	-	(0.01)	(0.36)	(0.00)	(0.06)	(0.03)	(0.00)
Telecommunication	0.2295	0.1020	-0.0837	0.2462	0.0213	-0.0128	0.1415
	-	(0.12)	(0.00)	(0.85)	(0.01)	(0.98)	(0.23)
Utilities	0.2467	0.2768	0.1518	0.2264	0.0477	0.1623	0.1554
	-	(0.68)	(0.31)	(0.78)	(0.05)	(0.06)	(0.28)

And not to forget transaction costs

Data set	1/J	fm	bms	mv	min	gri	qhs
Full sample	0.0610	0.0565	0.0578	0.0838	0.0780	0.0664	0.1283
01/1987 - 03/2000	0.0548	0.0555	0.0575	0.0903	0.0733	0.0590	0.1270
04/2000 - 10/2007	0.0634	0.0641	0.0601	0.0824	0.0788	0.0755	0.1253
11/2007 - 02/2013	0.0660	0.0478	0.0660	0.0772	0.0857	0.0699	0.1354
Europe	0.0624	0.0719	0.0382	0.0791	0.0786	0.0807	0.1280
North America	0.0636	0.0520	0.0469	0.0820	0.0779	0.0606	0.1243
Japan	0.0603	0.0456	0.0368	0.0636	0.0729	0.0652	0.1173
Asia ex Japan	0.0636	0.0749	0.0648	0.0900	0.0837	0.0876	0.1288

Monthly portfolio turnover as average sum of the absolute changes in portfolio weights across all stocks

Summary

- Alpha sources are well researched… methods to combine signals less so.

- Several methodologies exist to account for different properties of signals

- Method selection trades off fit versus model & estimation error

- Need large universe to benefit from higher complexity

- Personal preference: Markowitz Mean Variance

Thank you
for your attention