Quant Investing and Other Cross-Sectional Patterns
Financial Markets, Day 1, Class 5

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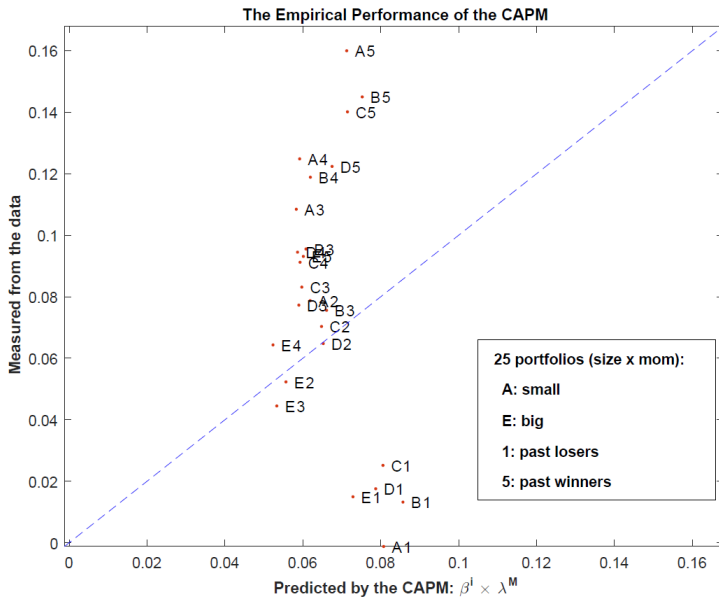
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Outline

- The momentum profit and the four factor model.
- Quant investing: crowded trades, over-used signals.
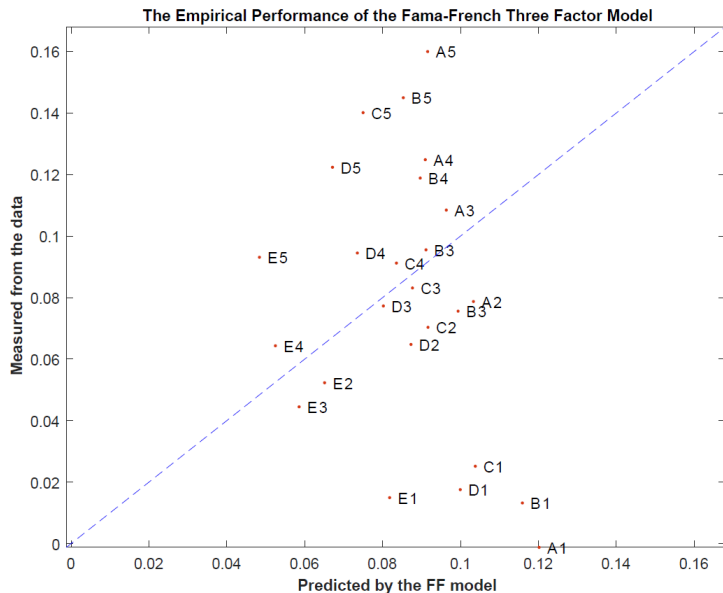- What next?

The Momentum Profit from Buying Winners and Selling Losers

- In a 1993 *Journal of Finance* article, Jegadeesh and Titman show that firms with high (low) returns in the prior year tend to have high (low) returns in the next few months

- In month t, sort stocks by their month t-12 to month t-2 cumulative returns, skipping month t-1 returns because of short-term reversal.

- The momentum profit looks impressive on paper, but the strategy involves high turnovers and transaction costs, and is also more volatile.

- Internationally, the evidence for momentum profit is strong, with the exception of a few countries including Japan.

- The momentum profit cannot be explained by the Fama-French factors: add the momentum factor to form the four-factor model.

Momentum Portfolios and the CAPM

The Empirical Performance of the CAPM

25 portfolios (size × mom):

A: small

E: big

1: past losers

5: past winners

x-axis: Predicted by the CAPM: $\beta^i \times \lambda^M$

y-axis: Measured from the data

Momentum Portfolios and the Three-Factor Model

The Empirical Performance of the Fama-French Three Factor Model

The Performance of Momentum Strategy in the CAPM

CAPM Alpha (in %, annualized by x12) with t-stat's

	1	2	3	4	5
A	**-8.19** [-3.31]	1.68 [1.00]	**5.01** [3.33]	**6.57** [4.36]	**8.87** [4.64]
B	**-7.25** [-3.44]	0.95 [0.65]	**3.47** [2.82]	**5.69** [4.54]	**6.97** [4.16]
C	**-5.54** [-2.78]	0.55 [0.46]	**2.34** [2.18]	**3.19** [3.08]	**6.87** [4.58]
D	**-6.11** [-3.08]	-0.05 [-0.04]	1.83 [1.98]	**3.59** [4.26]	**5.49** [4.03]
E	**-5.79** [-3.07]	-0.33 [-0.28]	-0.88 [-1.08]	1.20 [1.46]	**3.30** [2.70]

Monthly data from January 1962 through July 2015.

The Performance of Momentum Strategy in the FF3 Model

FF3 Alpha (in %, annualized by ×12) with t-stat's

	1	2	3	4	5
A	**-12.14** [-6.75]	**-2.46** [-2.66]	1.21 [1.56]	**3.39** [4.32]	**6.84** [6.20]
B	**-10.27** [-6.18]	**-2.38** [-2.47]	0.44 [0.60]	**2.92** [4.34]	**5.97** [5.82]
C	**-7.86** [-4.33]	**-2.13** [-2.19]	-0.45 [-0.59]	0.77 [0.97]	**6.51** [5.80]
D	**-8.24** [-4.24]	**-2.25** [-2.06]	-0.29 [-0.36]	**2.10** [2.69]	**5.52** [4.55]
E	**-6.68** [-3.54]	-1.28 [-1.12]	-1.41 [-1.90]	1.19 [1.57]	**4.47** [3.69]

Monthly data from January 1962 through July 2015.

The Winner/Loser Portfolios Tend to be More Volatile

The monthly market volatility is 4.46% for the same sample period.

Monthly Standard Deviation (in %)

	1	2	3	4	5
A	8.02	5.87	5.43	5.48	6.73
B	7.85	5.88	5.28	5.38	6.69
C	7.39	5.53	5.05	4.99	6.26
D	7.27	5.53	4.86	4.78	5.86
E	6.79	4.92	4.38	4.32	5.23

Monthly data from January 1962 through July 2015.

Momentum Profits around the World

Portfolio	Mean	Std. Dev.	t(mean)
Panel A: Country-Neutral Momentum Strategies			
All stocks (country-neutral)	0.0093	0.0239	5.36
By country:			
Austria	0.0080	0.0498	2.23
Belgium	0.0110	0.0444	3.42
Denmark	0.0109	0.0478	3.16
France	0.0097	0.0496	2.72
Germany	0.0072	0.0395	2.52
Italy	0.0093	0.0508	2.53
Netherlands	0.0126	0.0497	3.51
Norway	0.0099	0.0658	2.09
Spain	0.0132	0.0801	2.28
Sweden	0.0016	0.0632	0.36
Switzerland	0.0064	0.0428	2.08
United Kingdom	0.0089	0.0408	3.02

"International Momentum Strategies" by Rouwenhorst, *The Journal of Finance*, 1998.

The Momentum Factor

- Double sort stocks by size and prior (2-12 months) returns.
- Six value-weighted portfolios are formed monthly. For example, "Small High" contains small stocks with high (the top 30%) past (2-12 months) returns; "Big Low" contains large stocks with low (the bottom 30%) past (2-12 months) returns.
- The moment factor:

$$R^{\text{MOM}} = R^{\text{winner}} - R^{\text{loser}}$$

$R^{\text{winner}} = 1/2 \text{ (Small High + Big High)}$
$R^{\text{loser}} = 1/2 \text{ (Small Low + Big Low)}$

The Four-Factor Model

Add MOM to the Fama-French three-factor model:

$$E(R_t^i) - r_f = \beta_i \left(E(R_t^M) - r_f \right) + s_i\, E\left(R_t^{\text{SMB}} \right) + h_i\, E\left(R_t^{\text{HML}} \right) + w_i\, E\left(R_t^{\text{MOM}} \right)$$

where the market beta, size beta, value beta, and momentum beta can be estimated by the following regression:

$$R_t^i - r_f = \alpha_i + \beta_i \left(R_t^M - r_f \right) + s_i\, R_t^{\text{SMB}} + h_i\, R^{\text{HML}} + w_i\, R^{\text{MOM}} + \epsilon_t^i$$

The Factor Premiums and Volatility

From 1962 to 2014:

- Using annual returns:

$E(R^M - r_f)$	$E(R^{\text{SMB}})$	$E(R^{\text{HML}})$	$E(R^{\text{MOM}})$
6.46%	3.20%	5.15%	8.63%
[2.64]	[1.68]	[2.78]	[3.47]

- Using monthly returns:

$E(R^M - r_f)$	$E(R^{\text{SMB}})$	$E(R^{\text{HML}})$	$E(R^{\text{MOM}})$
0.49%	0.22%	0.36%	0.71%
[2.79]	[1.79]	[3.23]	[4.27]

- Factor volatility (monthly):

σ^M	σ^{SMB}	σ^{HML}	σ^{MOM}
4.46%	3.08%	2.84%	4.21%

The Performance of Fidelity Magellan

Fidelity Magellan, monthly returns

manager	tenure	mean excess	alpha	market beta	SMB beta	HML beta	MOM beta
Stansky	96-05	0.37 [0.74]	0.03 [0.35]	0.99 [50.41]	-0.14 [-7.72]	-0.04 [-1.46]	-0.01 [-0.50]
Vinik	92-96	0.95 [2.26]	-0.31 [-1.19]	1.00 [9.21]	0.12 [0.88]	0.07 [0.55]	0.29 [2.37]
Smith	90-92	0.80 [0.77]	0.26 [2.09]	1.14 [36.69]	0.01 [0.30]	-0.01 [-0.21]	-0.03 [-0.82]
Lynch	76-90	1.59 [3.45]	0.64 [5.01]	1.12 [36.38]	0.49 [9.67]	0.03 [0.59]	0.16 [4.08]
Habermann	72-76	-0.83 [-0.68]	0.42 [0.64]	1.00 [7.85]	0.79 [3.52]	-0.44 [-2.25]	0.07 [0.38]
Johnson	63-72	2.45 [3.32]	0.83 [2.60]	1.10 [11.67]	1.20 [10.07]	0.13 [0.90]	0.75 [7.36]

Popular Quant Signals

- **Valuation:** book-to-market, Fama and French 1992.
- **Momentum:** price momentum, Jegadeesh and Titman 1993.
- **Profitability:** earnings-to-sales ratio; profit/book-equity, Fama and French 2014.
- **Earnings Quality:** accruals to total assets, Sloan, 1996.
- **Analysts Sentiment:** earnings forecast revisions, Stickel, 1991.
- **Management Impact:** change in shares outstanding: seasoned equity offering, Loughran and Ritter 1994; share repurchases, Ikenberry, Lakonishok, and Vermaelan 1995. Investment (asset growth), Fama and French 2014.
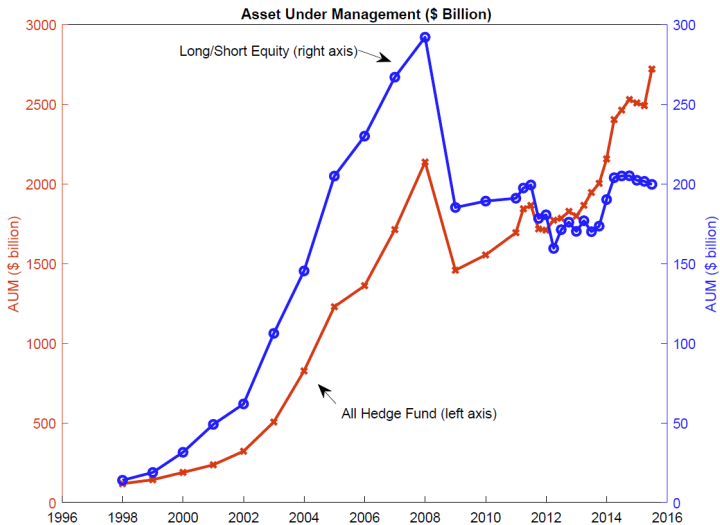
GSAM's Global Equity Opportunities

- $+1000$ positions on individual stocks.
- Market neutral and industry neutral.
- $+\$24$ billion and $-\$24$ billion with 6\$ billion AUM.
- The average holding period: in months.
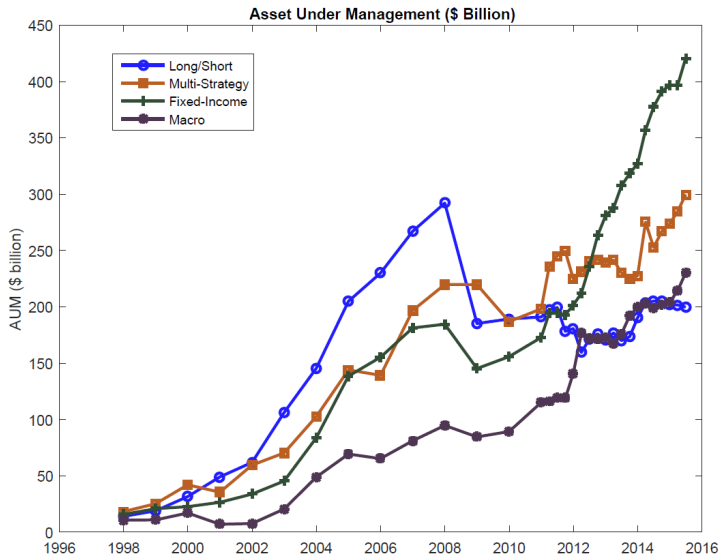- Correlation with different quant shops: very low.
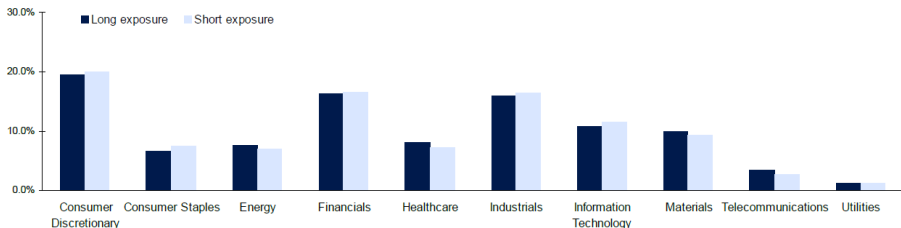
Source: Prof. Kent Daniel and Bob Litterman

The Growth of the Hedge Fund Industry

**Asset Under Management ($ Billion)**

Long/Short Equity (right axis)

All Hedge Fund (left axis)

Source: BarclayHedge

The Growth of the Hedge Fund Industry

Asset Under Management ($ Billion)

Legend: Long/Short, Multi-Strategy, Fixed-Income, Macro

Y-axis: AUM ($ billion), ranging from 0 to 450

X-axis: years from 1996 to 2016

GSAM's Global Equity Opportunities

- Up to June 2007, the average annual return was 15%, and volatility 10%.
- $10\%/\sqrt{52}$: 1.4% per week.
- In July 2007, down by -15%.
- From August 1 through 10, down by -30%.

**Global Equity Opportunities, Plc**
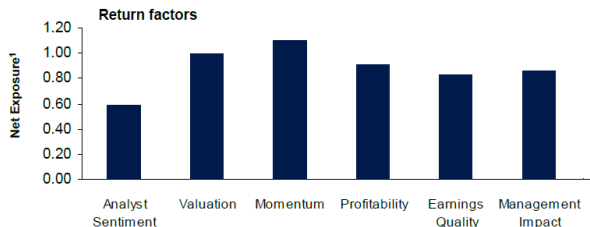
Source: Prof. Kent Daniel and Bob Litterman

Crowded Trades and Over-Used Signals

- By now, the well-established patterns such as value, size, and momentum have become common knowledge among money managers.

- Having a lot of institutional size money invested on the same set of well established trading strategies has become a problem for this space.

- Over-used signals in a over-crowded space: factor investing creates unwanted "quant risk."

- The 2007 quant meltdown is such an example. Lesson learned:
  - Cannot be too big: whale.
  - Cannot be too crowded: every runs for the exit.
 - Cannot be too transparent: front running.

Disruptions outside of quant investing

- Sub-prime mortgage market disruption (ABX BBB-Tranch).
- Spillover to investment-grade credit markets.
- Spillover to yen carry trade (USD/Yen exchange rate).
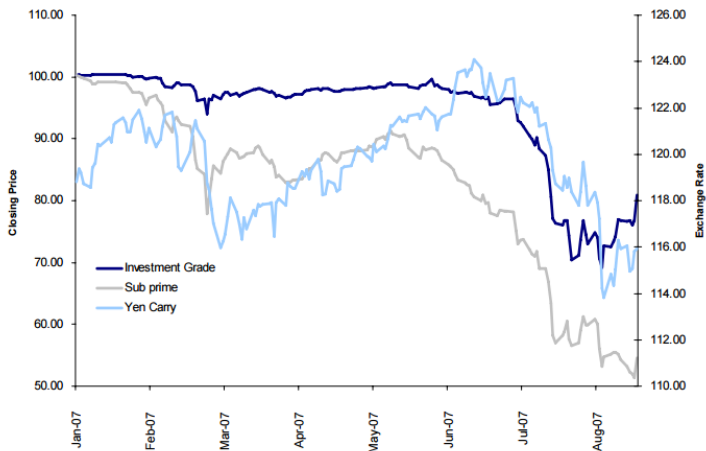
Contagion in Quant Factors

- Multi-strategy hedge funds, with losses in illiquid mortgage and credits, used the liquid holdings in their quant strategies to raise more cash.

- The meltdown affected virtually all quant factors in every major region. A 20-sigma drawdown for GSAM's Global Equity Opportunities Fund:

Theme Returns by Region
(01-Aug – 10-Aug-07)

**Theme Returns by Region**
(13-Aug – 31-Aug-07)
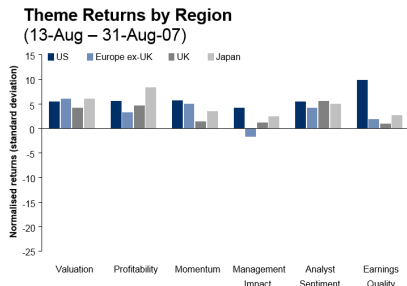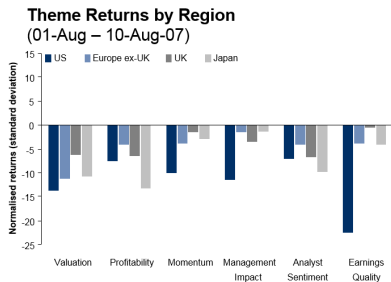
What Next?

- The search for new quant signals is still on, but this area is just not as exciting and creative as it was 10 or 15 years ago.
- An alpha that looks good on paper does not necessarily translate to real alpha. Transaction costs: price impact, especially when trading an institutional-size portfolio; and short-sale constraints.
- Some quant signals work only in small to medium stocks, but not large cap stocks. Some worked in the past, but have since disappeared.
- The push to equity mutual funds and ETFs is on going. Since 200907, AQR offers momentum funds for large-cap (AUM: $1B) and small-cap (AUM: $432M); Since 201304, Blackrock offers iShares momentum factor ETF ($870M).
- In this long-only space, a large portion of the risk exposure comes not from the quant signal, but from the market risk.

Portfolio returns of stocks, sorted by their options trading volume (put/call ratio)

	day relative to portfolio formation										
	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
	Panel A: average daily returns of PC-ranked portfolios (in basis points)										
low PC	31.4	25.0	15.5	12.1	11.4	10.2	9.3	6.9	8.7	7.2	7.8
PC 2	28.6	27.2	12.1	8.3	6.8	6.1	7.3	3.7	4.2	4.6	3.9
PC 3	15.5	12.5	7.1	6.1	5.4	5.6	4.6	4.6	5.2	6.4	3.6
PC 4	13.0	-0.3	3.1	2.1	6.4	4.7	5.2	6.4	6.1	5.1	7.2
high PC	-5.9	-14.6	-6.1	-0.8	-0.7	1.4	3.2	4.3	4.0	4.3	3.7
	Panel B: average daily returns of low-PC minus high-PC (in basis points)										
	37.4	39.6	21.6	12.9	12.1	8.8	6.2	2.6	4.7	2.9	4.1
t-stats	19.77	23.79	13.11	8.18	7.77	5.50	3.86	1.67	2.94	1.80	2.62

"The information in option volume for future stock prices" by Pan and Poteshman, *Review of Financial Studies,* 2006.

The Economic Link between Customers and Suppliers

Callaway ELY (customer) ◆—◆ Coastcast PAR ■—■
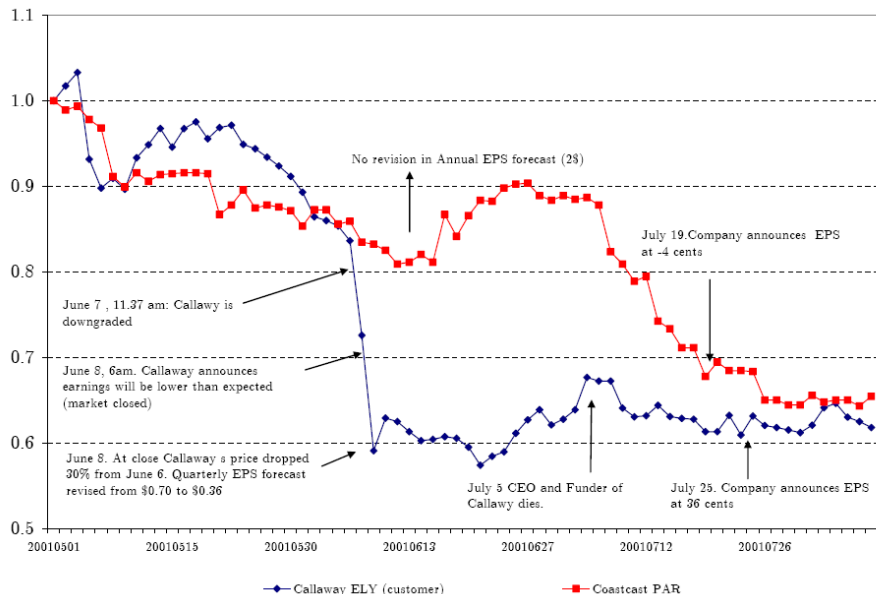
Portfolio Returns of Suppliers, Sorted by Past Returns of Their Customers

Value weights	xret	alpha	MKT	SMB	HML	UMD	R^2
Q1 (low)	-0.596 [-1.42]	-0.821 [-2.93]	0.989 [14.31]	0.384 [4.47]	-0.318 [-3.10]	-0.235 [-3.88]	0.626
Q2	-0.157 [-0.41]	-0.741 [-3.28]	1.057 [17.57]	0.307 [4.10]	-0.115 [-1.28]	-0.022 [-0.42]	0.658
Q3	0.125 [0.32]	-0.488 [-1.89]	1.063 [16.81]	0.309 [3.92]	-0.09 [-0.96]	-0.029 [-0.52]	0.633
Q4	0.313 [0.79]	-0.193 [-0.72]	1.039 [14.43]	0.217 [2.42]	-0.15 [-1.40]	-0.076 [-1.20]	0.564
Q5 (high)	0.982 [2.14]	0.556 [1.99]	0.982 [13.80]	0.681 [7.69]	-0.363 [-3.43]	-0.056 [-0.90]	0.650
L/S	1.578 [3.79]	1.376 [3.13]	-0.007 [-0.07]	0.296 [1.26]	-0.045 [-0.28]	0.179 [1.93]	0.041

"Economic links and predictable returns" by Cohen and Frazzini, *Journal of Finance,* 2008.