Quantitative Asset Management

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Lecture 3

- Momentum
  Jegadeesh and Titman (1993, JF)
- Momentum Crashes
  Daniel and Moskowitz (2016, JFE)

Returns to Buying Winners and Selling Losers: Implication for Stock Market Efficiency

Jegadeesh and Titman (1993, JF)

Summary

- Strategy: buy winner and sell losers
- Positive returns
- Systematic risk?
- Delayed price reaction?

Original Strategy

- Past returns based on past J months

  1, 2, 3, or 4 quarters
- Hold position for K months

  1, 2, 3, or 4 quarters
- Overlapping holding periods
- Strategy:
  - Sort stock based on past returns (past J months)
  - Construct 10 ew portfolio: losers and winner are the extreme deciles
  - Long winners and short losers
  - Hold this position for K months
  - Monthly rebalancing
  - Skip one week between formation and holding period

Table 1: Returns of Relative Strength Portfolios

		Panel A				Panel B			
J		$K =$ 3	6	9	12	$K =$ 3	6	9	12
3	Sell	0.0108	0.0091	0.0092	0.0087	0.0083	0.0079	0.0084	0.0083
		(2.16)	(1.87)	(1.92)	(1.87)	(1.67)	(1.64)	(1.77)	(1.79)
3	Buy	0.0140	0.0149	0.0152	.0156	0.0156	0.0158	0.0158	0.0160
		(3.57)	(3.78)	(3.83)	(3.89)	(3.95)	(3.98)	(3.96)	(3.98)
3	Buy-sell	0.0032	0.0058	0.0061	0.0069	0.0073	0.0078	0.0074	0.0077
		(1.10)	(2.29)	(2.69)	(3.53)	(2.61)	(3.16)	(3.36)	(4.00)
6	Sell	0.0087	0.0079	0.0072	0.0080	0.0066	0.0068	0.0067	0.0076
		(1.67)	(1.56)	(1.48)	(1.66)	(1.28)	(1.35)	(1.38)	(1.58)
6	Buy	0.0171	0.0174	0.0174	0.0166	0.0179	0.0178	0.0175	0.0166
		(4.28)	(4.33)	(4.31)	(4.13)	(4.47)	(4.41)	(4.32)	(4.13)
6	Buy-sell	0.0084	0.0095	0.0102	0.0086	0.0114	0.0110	0.0108	0.0090
		(2.44)	(3.07)	(3.76)	(3.36)	(3.37)	(3.61)	(4.01)	(3.54)
9	Sell	0.0077	0.0065	0.0071	0.0082	0.0058	0.0058	0.0066	0.0078
		(1.47)	(1.29)	(1.43)	(1.66)	(1.13)	(1.15)	(1.34)	(1.59)
9	Buy	0.0186	0.0186	0.0176	0.0164	0.0193	0.0188	0.0176	0.0164
		(4.56)	(4.53)	(4.30)	(4.03)	(4.72)	(4.56)	(4.30)	(4.04)
9	Buy-sell	0.0109	0.0121	0.0105	0.0082	0.0135	0.0130	0.0109	0.0085
		(3.03)	(3.78)	(3.47)	(2.89)	(3.85)	(4.09)	(3.67)	(3.04)
12	Sell	0.0060	0.0065	0.0075	0.0087	0.0048	0.0058	0.0070	0.0085
		(1.17)	(1.29)	(1.48)	(1.74)	(0.93)	(1.15)	(1.40)	(1.71)
12	Buy	0.0192	0.0179	0.0168	0.0155	0.0196	0.0179	0.0167	0.0154
		(4.63)	(4.36)	(4.10)	(3.81)	(4.73)	(4.36)	(4.09)	(3.79)
12	Buy-sell	0.0131	0.0114	0.0093	0.0068	0.0149	0.0121	0.0096	0.0069
		(3.74)	(3.40)	(2.95)	(2.25)	(4.28)	(3.65)	(3.09)	(2.31)

Size and beta

- Focus on 6-month/6-month strategy
- Post-ranking betas
- Average market capitalization

- Why do we care about these stats?

Table 2

	Beta	Average Market Capitalization
P1	1.36	208.24
P2	1.19	480.07
P3	1.14	545.31
P4	1.11	618.85
P5	1.09	692.89
P6	1.08	702.51
P7	1.09	738.09
P8	1.12	758.87
P9	1.17	680.18
P10	1.28	495.13
P10–P1	−0.08	—

Driven by size or beta?

- Test whether strategies work in subsample
- Subsample by size: small, medium, large mkt caps
- Subsample by mkt beta: small, medium, large beta

- Is this a double sort?
- Can this subsample analysis help to disentangle from other explanations? Why?

Table 3

Panel A: Average Monthly Returns

	All	S1	S2	S3	β_1	β_2	β_3
P1	0.0079	0.0083	0.0047	0.0082	0.0129	0.0097	0.0052
	(1.56)	(1.35)	(0.99)	(2.22)	(2.92)	(2.01)	(0.95)
P2	0.0112	0.0117	0.0102	0.0098	0.0140	0.0128	0.0086
	(2.78)	(2.29)	(2.54)	(3.08)	(4.38)	(3.37)	(1.83)
P3	0.0125	0.0152	0.0125	0.0105	0.0132	0.0133	0.0102
	(3.40)	(3.23)	(3.34)	(3.53)	(4.59)	(3.77)	(2.28)
P4	0.0124	0.0163	0.0130	0.0105	0.0134	0.0128	0.0110
	(3.59)	(3.59)	(3.58)	(3.66)	(5.02)	(3.82)	(2.50)
P5	0.0128	0.0164	0.0134	0.0109	0.0135	0.0135	0.0121
	(3.87)	(3.74)	(3.83)	(3.85)	(5.14)	(4.15)	(2.86)
P6	0.0134	0.0174	0.0146	0.0102	0.0135	0.0142	0.0122
	(4.14)	(4.08)	(4.22)	(3.66)	(5.23)	(4.38)	(2.92)
P7	0.0136	0.0175	0.0143	0.0109	0.0136	0.0142	0.0126
	(4.19)	(4.13)	(4.12)	(3.90)	(5.09)	(4.43)	(3.01)
P8	0.0143	0.0174	0.0148	0.0111	0.0143	0.0146	0.0132
	(4.30)	(4.11)	(4.16)	(3.86)	(5.12)	(4.44)	(3.15)
P9	0.0153	0.0183	0.0154	0.0126	0.0165	0.0156	0.0141
	(4.36)	(4.28)	(4.11)	(4.17)	(5.34)	(4.56)	(3.28)
P10	0.0174	0.0182	0.0173	0.0157	0.0191	0.0176	0.0160
	(4.33)	(3.99)	(4.11)	(4.41)	(5.17)	(4.53)	(3.50)
P10−P1	0.0095	0.0099	0.0126	0.0075	0.0062	0.0079	0.0108
	(3.07)	(2.77)	(4.57)	(3.03)	(2.05)	(2.64)	(3.35)
F-Statistics[a]	2.83	2.65	4.51	4.38	2.51	1.99	1.69
p-Value	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.04)	(0.09)

Subperiod Analysis

- Seasonal effects?
- Does the strategy work for January data as well?

- 5-year subperiods?

Takeaway

- Paper documents momentum anomaly:
  - Strategy in the paper is different from today's standard
  - Recent paper (mostly) don't use overlapping holding periods
- Techniques:
  - Overlaping holding periods
  - Example of how to use sequential double sort
  - Subperiod analysis: e.g. by month or 5-year windows

Momentum Crashes

Daniel and Moskowitz (2016, JFE)

Momentum

- Momentum strategies deliver high Sharpe ratios (so far...)
- It's everywhere: different assets classes, countries, industries
- Exhibit significant negative skewness
  - April 2009 return was -45.52%, the second worst since 1932
  - There is an HBS case about it
  - Monthly momentum return skewness is -4.7, while the market is -0.57
- Maximum monthly momentum return in our sample: 26.1%
- The 5 worst are -74%, -61%, -49%, -46%, and -44%

Portfolio Construction

- CRSP share codes 10 and 11
- NYSE, AMAX, Nasdaq
- Valid share price and number of shares on the formation date
- At least 8 month of past return data
- Rank stock based on their cumulative returns from $t-12$ to $t-1$
- Skip one month as formation period
- Sort stocks into deciles

Table 1

Momentum portfolio characteristics, 1927:01–2013:03.

This table presents characteristics of the monthly momentum decile portfolio excess returns over the 87-year full sample period from 1927:01 through 2013:03. The decile 1 portfolio—the loser portfolio—contains the 10% of stocks with the worst losses, and decile 10—the winner portfolio—contains the 10% of the stocks with the largest gains. WML is the zero-investment winner-minus-loser portfolio which is long the Decile 1 and short the Decile 10 portfolio. The mean excess return, standard deviation, and alpha are in percent, and annualized. SR denotes the annualized Sharpe Ratio. The α, $t(\alpha)$, and β are estimated from a full-period regression of each decile portfolio's excess return on the excess Center for Research in Securities Prices value-weighted index. For all portfolios except WML, sk(m) denotes the full-period realized skewness of the monthly log returns (not excess) to the portfolios and sk(d) denotes the full-period realized skewness of the daily log returns. For WML, sk is the realized skewness of $\log(1+r_{WML}+r_f)$.

Return statistic	Momentum decile portfolios										WML	Market
	1	2	3	4	5	6	7	8	9	10		
$\overline{r-r_f}$	−2.5	2.9	2.9	6.4	7.1	7.1	9.2	10.4	11.3	15.3	17.9	7.7
σ	36.5	30.5	25.9	23.2	21.3	20.2	19.5	19.0	20.3	23.7	30.0	18.8
α	−14.7	−7.8	−6.4	−2.1	−0.9	−0.6	1.8	3.2	3.8	7.5	22.2	0
$t(\alpha)$	(−6.7)	(−4.7)	(−5.3)	(−2.1)	(−1.1)	(−1.0)	(2.8)	(4.5)	(4.3)	(5.1)	(7.3)	(0)
β	1.61	1.41	1.23	1.13	1.05	1.02	0.98	0.95	0.99	1.03	−0.58	1
SR	−0.07	0.09	0.11	0.28	0.33	0.35	0.47	0.54	0.56	0.65	0.60	0.41
sk(m)	0.09	−0.05	−0.19	0.21	−0.13	−0.30	−0.55	−0.54	−0.76	−0.82	−4.70	−0.57
sk(d)	0.12	0.29	0.22	0.27	0.10	−0.10	−0.44	−0.66	−0.67	−0.61	−1.18	−0.44

Figure 1

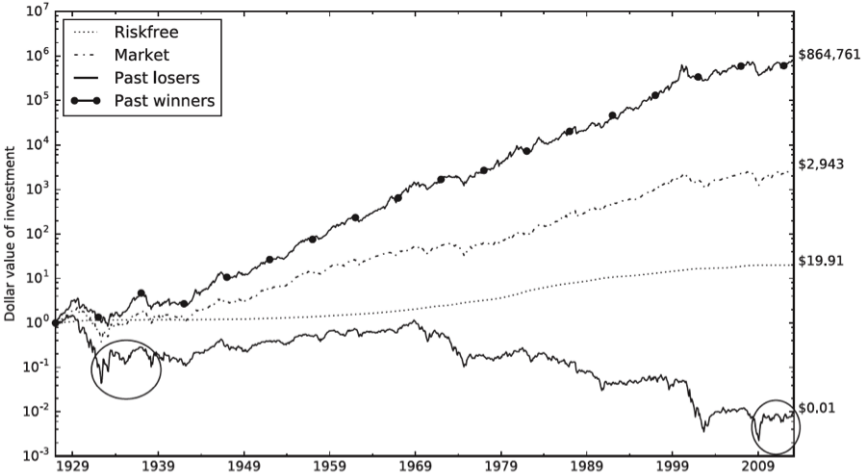


Fig. 1. Winners and losers, 1927–2013. Plotted are the cumulative returns to four assets: (1) the risk-free asset; (2) the Center for Research in Security Prices (CRSP) value-weighted index; (3) the bottom decile "past loser" portfolio and (4) the top decile "past winner" portfolio over the full sample period 1927:01 to 2013:03. To the right of the plot we tabulate the final dollar values for each of the four portfolios, given a $1 investment in January 1927.

Figure 2

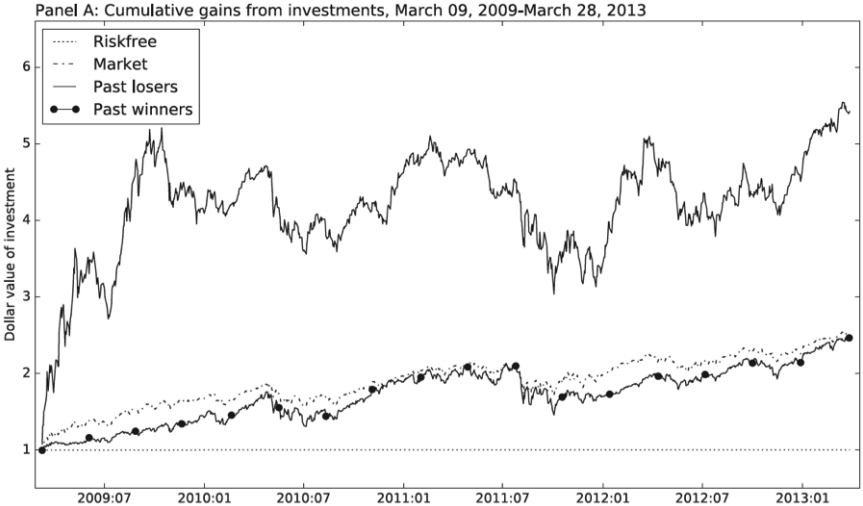

Panel A: Cumulative gains from investments, March 09, 2009-March 28, 2013
Riskfree
Market
Past losers
Past winners
Dollar value of investment
1
2
3
4
5
6
2009:07
2010:01
2010:07
2011:01
2011:07
2012:01
2012:07
2013:01

Figure 2

Panel B: Cumulative gains from investments, June 01, 1932-December 30, 1939
Dollar value of investment
1
2
3
4
5
6
1933
1934
1935
1936
1937
1938
1939
1940
Riskfree
Market
Past losers
Past winners

Table 2

This table lists the 15 worst monthly returns to the winner-minus-loser (WML) momentum portfolio over the 1927:01–2013:03 time period. Also tabulated are Mkt-2y, the two-year market returns leading up to the portfolio formation date, and Mkt_t, the contemporaneous market return. The dates between July 1932 and September 1939 are marked with an asterisk (*), those between April and August of 2009 with †, and those from January 2001 and November 2002 with ‡. All numbers in the table are in percent.

Rank	Month	WML_t	MKT-2y	Mkt_t
1	1932:08*	−74.36	−67.77	36.49
2	1932:07*	−60.98	−74.91	33.63
3	2001:01‡	−49.19	10.74	3.66
4	2009:04†	−45.52	−40.62	10.20
5	1939:09*	−43.83	−21.46	16.97
6	1933:04*	−43.14	−59.00	38.14
7	2009:03†	−42.28	−44.90	8.97
8	2002:11‡	−37.04	−36.23	6.08
9	1938:06*	−33.36	−27.83	23.72
10	2009:08†	−30.54	−27.33	3.33
11	1931:06*	−29.72	−47.59	13.87
12	1933:05*	−28.90	−37.18	21.42
13	2001:11‡	−25.31	−19.77	7.71
14	2001:10‡	−24.98	−16.77	2.68
15	1974:01	−24.04	−5.67	0.46

Momentum Losses

- Momentum strategy suffers worst performance at turning points following large market declines: market bottomed.
- As of March 2009, many the firms in the Loser portfolio had fallen by 90% or more.
  - Firms like Citigroup, Bank of America, Ford, GM
- Time-varying betas
- Momentum seems to get very negatively exposed to the market when crashes
- Estimate time-varying betas: 126-day rolling window using daily data

Figure 3

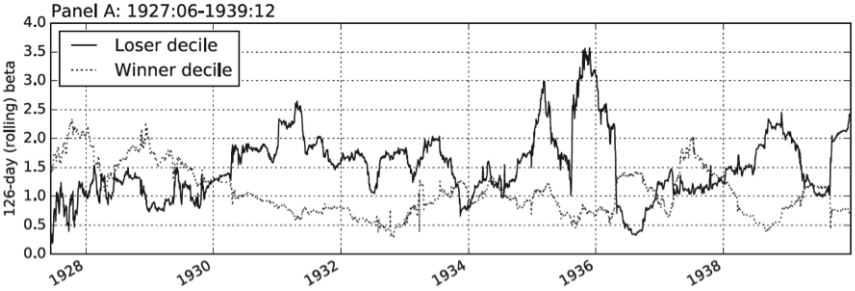

Panel A: 1927:06-1939:12
Loser decile
Winner decile
126-day (rolling) beta
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1928
1930
1932
1934
1936
1938

Figure 3

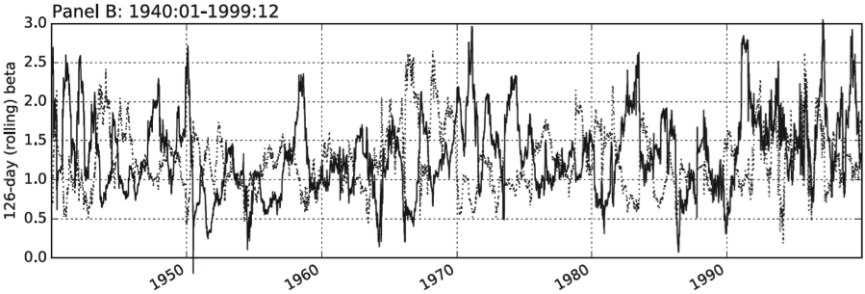
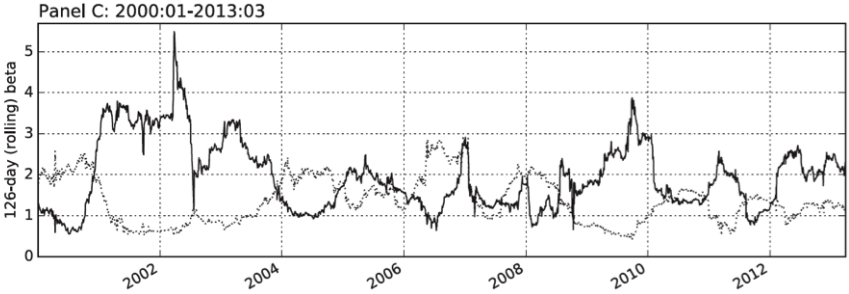

Panel B: 1940:01-1999:12
126-day (rolling) beta
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1950
1960
1970
1980
1990

Figure 3


Panel C: 2000:01-2013:03
126-day (rolling) beta
0
1
2
3
4
5
2002
2004
2006
2008
2010
2012

Option-like behavior

Estimate:

$$\begin{aligned}\tilde{R}_{\mathrm{WML},t} = &(\alpha_0 + \alpha_B \cdot I_{B,t-1}) \\ &+ (\beta_0 + I_{B,t-1}(\beta_B + \tilde{I}_{U,t}\beta_{B,U}))\tilde{R}_{m,t} + \tilde{\epsilon}_t\end{aligned}$$

where

- I_B bear market dummy (past 2 years)
- I_U contemporaneous up market dummy

Table 3

This table presents the results of estimating four specifications of a monthly time-series regressions run over the period 1927:01 to 2013:03. In all cases the dependent variable is the return on the WML portfolio. The independent variables are a constant; an indicator for bear markets, $I_{B,t-1}$, which equals one if the cumulative past two-year return on the market is negative; the excess market return, $R^e_{m,t}$; and a contemporaneous up-market indicator, $I_{U,t}$, which equals one if $R^e_{m,t} > 0$. The coefficients $\hat{\alpha}_0$ and $\hat{\alpha}_B$ are multiplied by 100 (i.e., are in percent per month).

Coefficient	Variable	Estimated coefficients (t-statistics)			
		(1)	(2)	(3)	(4)
$\hat{\alpha}_0$	1	1.852	1.976	1.976	2.030
		(7.3)	(7.7)	(7.8)	(8.4)
$\hat{\alpha}_B$	$I_{B,t-1}$		−2.040	0.583	
			(−3.4)	(0.7)	
$\hat{\beta}_0$	$\tilde{R}^e_{m,t}$	−0.576	−0.032	−0.032	−0.034
		(−12.5)	(−0.5)	(−0.6)	(−0.6)
$\hat{\beta}_B$	$I_{B,t-1} \cdot \tilde{R}^e_{m,t}$		−1.131	−0.661	−0.708
			(−13.4)	(−5.0)	(−6.1)
$\hat{\beta}_{B,U}$	$I_{B,t-1} \cdot I_{U,t} \cdot \tilde{R}^e_{m,t}$			−0.815	−0.727
				(−4.5)	(−5.6)
R^2_{adj}		0.130	0.269	0.283	0.283

Takeaway

- Momentum is very different in normal times versus crashes
- In panic states, past losers have a high premium
- As market conditions improve, losers experience strong gains and momentum crashes happen
- The expected gains from the loser portfolio are related to both past market losses, and lagged market volatility.