Risk Factors in Equity Markets Cont'd

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Outline

A 4-Factor Model

Higher risk premium than other 3

- **Momentum effect:** Stocks that have done well over the past year (Winners) tend to have higher average returns than stocks with the lowest returns over the same period (Losers) (Jegadeesh and Titman (1993)).

higher alpha even in FF3

- Carhart (1997): proposed a four-factor model for U.S. returns in an attempt to also capture momentum returns:

$$\begin{aligned} r_{i,t} - r_{f,t} &= \alpha_i + \beta_{i,m}\left(r_{m,t} - r_{f,t}\right) + \beta_{i,SMB} r_{SMB,t} \\ &\quad + \beta_{i,HML} r_{HML,t} + \beta_{i,WML} r_{WML,t} + \varepsilon_{i,t} \end{aligned}$$

  - $r_{WML,t}$ is a factor mimicking portfolio constructed to capture the momentum return.

Performance of Momentum

Table I

Average Excess Returns to Momentum Strategies

A momentum strategy is defined by the triplet (J, S, K), where J is the ranking period (according to past J-month cumulative return), S is a skip period (set to one month in all the strategies below), and K is the holding period. Every month stocks are sorted according to the chosen ranking period (J). After skipping one month (S), portfolios are formed using stocks in the top decile (winners) and in the lower decile (losers). The portfolios are held for K months. This process is repeated every month, while a $1/K$ fraction of each portfolio is rebalanced. The time-series means of momentum portfolio monthly returns (excess of the risk-free rate), as well as the associated t-statistics (two-digit numbers), are presented below for various ranking and holding periods. The analysis is performed separately using NYSE-listed stocks, and using all NYSE, AMEX, and Nasdaq stocks. Panel A uses equal weights for each stock while forming the portfolios, and Panel B uses value (market capitalization) weights. The average monthly excess returns of the NYSE-composite and the NYSE/AMEX/Nasdaq-composite are 0.0061 and 0.0072 (equal-weighted), and 0.0053 and 0.0056 (value-weighted), respectively. The analysis uses data for the period February 1967 to December 1999 (395 months).

	NYSE					NYSE + AMEX + Nasdaq				
	K					K				
J	1	3	6	12		J	1	3	6	12
Panel A: Equal-Weighted Strategies										
Winners										
2	0.0098	0.0101	0.0108	0.0112		2	0.0077	0.0084	0.0089	0.0094
	3.13	3.24	3.45	3.53			2.27	2.53	2.69	2.80
5	0.0128	0.0132	0.0139	0.0124		5	0.0108	0.0111	0.0114	0.0097
	4.04	4.15	4.36	3.89			3.23	3.34	3.43	2.93
11	0.0170	0.0160	0.0146	0.0117		11	0.0147	0.0134	0.0116	0.0085
	5.13	4.80	4.41	3.59			4.26	3.92	3.44	2.54
Losers										
2	0.0055	0.0050	0.0048	0.0051		2	0.0056	0.0042	0.0043	0.0052
	1.44	1.35	1.33	1.44			1.38	1.03	1.07	1.34
5	0.0029	0.0028	0.0029	0.0044		5	0.0046	0.0037	0.0038	0.0052
	0.74	0.71	0.76	1.18			1.07	0.85	0.90	1.27
11	0.0012	0.0014	0.0026	0.0057		11	0.0028	0.0029	0.0042	0.0075
	0.29	0.34	0.66	1.45			0.63	0.67	0.95	1.73

AQR Applied Quantitative Research

robust enough!

may affect prices ⇒ avoid buying @ worst prices. wait for one month to do the trade

$H_0: E(r_W) = E(r_L)$
$H_1: E(r_W) \neq E(r_L)$

partially control for size

add many small firms

size effect - end of Dec, 1966

confront momentum

reduce magnitude of difference

(money)

confidently reject null

$E(r_W) - E(r_L)$
$= 11.7\% - 6.5\%$
$= 5.2\%$ annually

$J=2, S=1, K=1$
Feb 1967 – Dec 1999

① For every stock i, caculate cumulative return over end of Oct, 1966 end of Feb 1967 (earned return)

② skip period = end of Dec 1966 – end of Jan 1967
portfolio formed at the end of Dec 1966

$$R_i = \frac{P_{Dec.1966} + D}{P_{Oct.1966}} - 1$$

TOP 10%. cumulative return : Winner
Bottom 10%. : loser

③ Place trade corresponding to W and L at end of Jan, 1967 – end of Feb, 1967

Repeat ①-③ for each month.

Nov, 1966 – Jan, 1967
Feb, 1967 – March, 1967
March, 1967 – April, 1967

Performance of Momentum cont'd

eliminating size effect (partially)

Market Cap

Your buy won't account for a large proportion for the company
=> avoid moving prices
but less importance in small firms.

Panel B: Value-Weighted Strategies

				Winners					
2	0.0070	0.0074	0.0072	0.0077	2	0.0085	0.0091	0.0083	0.0084
	2.44	2.70	2.65	2.82		2.66	2.97	2.78	2.81
5	0.0081	0.0087	0.0096	0.0085	5	0.0099	0.0100	0.0103	0.0088
	2.80	3.09	3.43	3.04		3.09	3.23	3.34	2.89
11	0.0117	0.0117	0.0106	0.0087	11	0.0130	0.0128	0.0111	0.0084
	3.84	3.90	3.51	2.93		3.92	3.91	3.42	2.66
				Losers					
2	0.0035	0.0034	0.0034	0.0025	2	−0.0024	−0.0012	−0.0002	−0.0001
	1.06	1.11	1.12	0.86		−0.65	−0.35	−0.06	−0.03
5	0.0018	0.0023	0.0014	0.0019	5	−0.0054	−0.0039	−0.0025	−0.0010
	0.53	0.69	0.42	0.61		−1.42	−1.05	−0.70	−0.27
11	−0.0025	−0.0015	−0.0002	0.0022	11	−0.0083	−0.0065	−0.0040	0.0006
	−0.72	−0.41	−0.06	0.65		−2.10	−1.65	−1.02	0.16

gain from long end and short end.

Fama and French (2012)

- In US dollars
- In excess of US one-month T-bill

- Combine 23 developed markets into four regions:
  1. North America (US, Canada)
  2. Japan
  3. Asia Pacific (Australia, New Zealand, Hong Kong, Singapore)
  4. Europe
- In each region, sort stocks on size and momentum and on size and BE/ME. To avoid undo weight on tiny stocks:
  - BE/ME and momentum breakpoints are based on large stocks.
  - Size breakpoints are based are percents of aggregate market cap.
- Global portfolios use global size breaks but regional BE/ME and momentum breakpoints.

$HML_S = SH - SL$
$HML_B = BH - BL$
$HML = \frac{1}{2}(HML_S + HML_B)$

top 10%
bottom 10%

US $\frac{S}{B}$ based on NYSE median = top 10%

Summary Statistics of Factors

Table 1
Summary statistics for explanatory returns: November 1990–March 2011, 245 months.

We examine regional portfolios for North America, Europe, Japan, and Asia Pacific (excluding Japan) and Global portfolios that combine the four regions. We form portfolios at the end of June of each year t by sorting stocks in a region into two market cap and three book-to-market equity (B/M) groups. Big stocks are those in the top 90% of June market cap for the region, and small stocks are those in the bottom 10%. The B/M breakpoints for the four regions are the 30th and 70th percentiles of B/M for the big stocks of a region. The global portfolios use global size breaks, but we use the B/M breakpoints for the four regions to allocate the stocks of these regions to the global portfolios. The independent 2 × 3 sorts on size and B/M produce six value-weight portfolios, *SG*, *SN*, *SV*, *BG*, *BN*, and *BV*, where S and B indicate small or big and G, N, and V indicate growth, neutral, and value (bottom 30%, middle 40%, and top 30% of B/M). *SMB* is the equal-weight average of the returns on the three small stock portfolios for the region minus the average of the returns on the three big stock portfolios. We construct value—growth returns for small and big stocks, $HML_S = SV - SG$ and $HML_B = BV - BG$, and *HML* is the equal-weight average of HML_S and HML_B. The 2 × 3 sorts on size and lagged momentum are similar, but the size-momentum portfolios are formed monthly. For portfolios formed at the end of month t, the lagged momentum return is a stock's cumulative return for $t-11$ to $t-1$. The independent 2 × 3 sorts on size and momentum produce six value-weight portfolios, *SL*, *SN*, *SW*, *BL*, *BN*, and *BW*, where S and B indicate small and big and L, N, and W indicate losers, neutral, and winners (bottom 30%, middle 40%, and top 30% of lagged momentum). We construct winner—loser returns for small and big stocks, $WML_S = SW - SL$ and $WML_B = BW - BL$, and *WML* is the equal-weight average of WML_S and WML_B. $HML_{S\text{-}B}$ ($WML_{S\text{-}B}$) is the difference between HML_S and HML_B (WML_S and WML_B). All returns are in U.S. dollars. Market is the return on a region's value-weight market portfolio minus the U.S. one-month T-bill rate. The mean value of the T-bill rate is 0.28%. Mean and Std dev are the mean and standard deviation of the return, and *t*-Mean is the ratio of Mean to its standard error.

	Market	*SMB*	*HML*	HML_S	HML_B	$HML_{S\text{-}B}$	*WML*	WML_S	WML_B	$WML_{S\text{-}B}$
Global										
Mean	0.44	0.09	0.45	0.66	0.24	0.42	0.62	0.82	0.41	0.41
Std dev	4.37	2.19	2.46	2.73	2.74	2.39	4.20	4.09	4.68	2.60
t-Mean	1.57	0.69	2.85	3.78	1.36	2.76	2.30	3.14	1.38	2.46
North America										
Mean	0.66	0.24	0.33	0.56	0.10	0.46	0.64	0.85	0.44	0.40
Std dev	4.39	3.28	3.54	4.38	3.31	3.22	5.27	5.35	5.61	3.03
t-Mean	2.35	1.16	1.48	2.01	0.49	2.23	1.91	2.47	1.23	2.09
Europe										
Mean	0.56	−0.06	0.55	0.69	0.42	0.27	0.92	1.34	0.50	0.85
Std dev	4.95	2.39	2.48	2.83	2.98	3.05	4.26	3.98	4.99	2.98
t-Mean	1.77	−0.38	3.51	3.81	2.21	1.38	3.38	5.29	1.56	4.44
Japan										
Mean	−0.12	−0.09	0.48	0.47	0.50	−0.03	0.08	0.00	0.15	−0.14
Std dev	6.03	3.46	2.93	3.08	3.87	3.81	4.74	4.34	5.88	4.12
t-Mean	−0.31	−0.42	2.59	2.38	2.02	−0.13	0.25	0.02	0.39	−0.54
Asia Pacific										
Mean	0.86	−0.21	0.62	0.93	0.32	0.61	0.69	0.99	0.39	0.61
Std dev	6.14	3.07	3.22	3.29	4.22	3.98	4.81	4.49	5.93	4.23
t-Mean	2.19	−1.05	3.04	4.42	1.19	2.39	2.24	3.47	1.02	2.25

Summary Statistics of LHS Returns

Table 2
Summary statistics for the 25 size-B/M and size-momentum excess returns for November 1990–March 2011, 245 months.

At the end of June of each year, we construct 25 size-B/M portfolios for each region. The size breakpoints are the 3rd, 7th, 13th, and 25th percentiles of aggregate market cap for a region. The B/M quintile breakpoints use the big stocks (top 90% of market cap) of a region. The global portfolios use global size breakpoints, but the separate quintile B/M breakpoints for North America, Europe, Japan, and Asia Pacific are used to allocate the stocks of these regions to the global portfolios. The intersections of the 5 × 5 independent size and B/M sorts for a region produce 25 value-weight size-B/M portfolios. The 5 × 5 sorts on size and momentum use the same breakpoint conventions as the size-B/M sorts, except that the size-momentum portfolios are formed monthly. For portfolios formed at the end of month t, the lagged momentum return is a stock's cumulative monthly return for $t-11$ to $t-1$. The intersections of the independent 5 × 5 size and momentum sorts produce 25 value-weight portfolios for each region.

Panel A: Monthly excess returns for 25 portfolios formed on size and B/M

B/M → increase

	Mean					Standard deviation				
size ↓	Low	2	3	4	High	Low	2	3	4	High
Global										
Small	0.07	0.48	0.77	0.83	1.12	5.94	5.48	5.09	4.64	4.38
2	0.09	0.46	0.59	0.69	0.79	5.87	5.21	4.68	4.40	4.56
3	0.21	0.40	0.52	0.57	0.74	5.78	5.19	4.64	4.47	4.65
4	0.37	0.43	0.52	0.60	0.69	5.66	4.61	4.50	4.47	4.78
Big	0.29	0.36	0.49	0.53	0.53	4.62	4.29	4.41	4.45	5.40
North America										
Small	0.50	0.75	1.13	1.04	1.42	8.48	7.15	6.42	5.50	5.43
2	0.34	0.73	0.95	0.94	1.08	7.77	6.82	5.73	4.90	5.24
3	0.90	0.70	0.87	0.86	1.08	7.34	6.02	5.14	4.67	5.03
4	0.80	0.73	0.89	0.84	0.96	6.97	5.29	4.76	4.75	4.79
Big	0.54	0.56	0.62	0.66	0.64	4.84	4.35	4.32	4.35	5.48
Europe										
Small	−0.13	0.29	0.44	0.66	0.88	5.79	5.50	5.21	4.94	4.89
2	0.10	0.42	0.53	0.78	0.89	6.13	5.40	5.15	5.14	5.26
3	0.21	0.54	0.62	0.62	0.86	6.01	5.32	5.10	5.30	5.47
4	0.39	0.57	0.66	0.64	0.88	5.57	4.90	5.10	5.29	5.81
Big	0.31	0.52	0.65	0.76	0.73	5.09	4.83	5.16	5.56	6.44
Japan										
Small	−0.17	−0.08	0.02	0.08	0.22	9.32	7.81	7.58	7.31	7.25
2	−0.45	−0.37	−0.13	0.01	0.03	8.30	7.78	7.17	7.08	7.23
3	−0.42	−0.39	−0.27	−0.16	0.13	7.93	7.06	6.72	6.46	6.97
4	−0.50	−0.18	−0.21	0.00	0.05	7.51	6.44	6.06	6.05	6.84
Big	−0.33	−0.10	−0.10	0.18	0.35	6.95	5.99	6.15	6.02	7.44
Asia Pacific										
Small	0.39	0.61	0.87	1.17	1.61	8.18	8.03	7.36	7.34	7.42
2	0.17	0.51	0.63	0.79	1.06	7.21	7.72	6.91	7.23	7.94
3	0.10	0.77	0.88	1.00	0.92	7.37	6.88	6.76	7.04	8.04
4	0.90	0.96	0.66	1.08	1.16	6.67	6.20	6.35	6.95	8.49
Big	0.69	0.97	0.95	0.94	1.13	6.52	6.25	6.45	6.90	8.11

don't observe a trend for size effect.

micro cap growth (hard to explain)

Summary Statistics of LHS Returns cont'd

Panel B: Monthly excess returns for 25 portfolios formed on size and momentum

	Mean					Standard deviation				
	Low	2	3	4	High	Low	2	3	4	High
Global										
Small	0.20	0.66	0.80	1.15	1.57	6.42	4.36	3.95	4.07	5.43
2	0.17	0.52	0.54	0.78	1.12	6.72	4.65	4.19	4.19	5.54
3	0.28	0.46	0.55	0.57	0.85	6.64	4.87	4.26	4.18	5.51
4	0.26	0.46	0.52	0.57	0.86	6.59	4.78	4.18	4.20	5.35
Big	0.12	0.32	0.38	0.55	0.61	6.26	4.57	4.09	4.15	5.36
North America										
Small	0.54	0.96	1.19	1.51	1.96	7.71	5.05	4.73	5.26	7.09
2	0.52	0.95	0.95	1.00	1.50	7.94	5.17	4.81	4.88	7.47
3	0.57	0.75	0.90	1.07	1.27	7.45	5.13	4.49	4.71	6.91
4	0.54	0.79	0.84	0.82	1.29	7.35	4.76	4.30	4.41	6.54
Big	0.36	0.52	0.44	0.74	0.97	6.55	4.55	3.96	4.21	6.22
Europe										
Small	−0.28	0.38	0.61	1.03	1.75	6.53	4.85	4.52	4.41	5.51
2	−0.16	0.46	0.66	0.88	1.45	6.90	5.34	4.86	4.71	5.60
3	0.19	0.43	0.63	0.77	1.11	6.97	5.37	4.95	4.84	5.65
4	0.27	0.52	0.65	0.77	1.11	7.22	5.45	4.92	4.96	5.37
Big	0.22	0.47	0.69	0.65	0.77	7.46	5.64	4.77	4.74	5.51
Japan										
Small	0.17	0.26	0.15	0.24	−0.05	8.87	7.20	6.65	6.48	7.88
2	−0.10	−0.03	−0.06	0.03	−0.09	8.71	7.10	6.59	6.64	7.35
3	−0.14	−0.22	−0.12	−0.02	−0.05	8.09	6.86	6.12	6.22	6.92
4	−0.11	−0.11	−0.18	−0.16	−0.05	7.99	6.57	6.10	5.91	6.68
Big	−0.10	−0.28	−0.31	−0.12	−0.06	8.31	6.53	6.17	5.89	6.84
Asia Pacific										
Small	0.60	1.04	1.31	1.95	1.73	8.56	6.88	6.48	6.86	8.03
2	−0.14	0.83	0.85	1.08	1.18	9.01	7.20	6.35	6.48	7.72
3	0.18	0.60	0.71	1.19	1.24	8.77	6.78	6.15	6.58	7.85
4	0.48	0.96	0.85	0.99	1.23	8.59	7.29	5.83	5.98	7.74
Big	1.11	0.72	1.07	1.06	1.12	8.74	7.24	6.81	6.35	7.00

Summary Statistics for Time Series Regressions

Table 3
Summary statistics for regressions to explain monthly excess returns on portfolios from sorts on size and B/M, with (5 × 5) and without (4 × 5) microcaps: November 1990 to March 2011.

The regressions use the CAPM, three-factor (1), and four-factor (2) models with global or local factors to explain the returns on Global, North American, European, Japanese, and Asia Pacific portfolios formed on size and B/M. The 5 × 5 results include all five size quintiles; the 4 × 5 results exclude microcap portfolios. The GRS statistic tests whether all intercepts in a set of 25 (5 × 5) or 20 (4 × 5) regressions are zero; $|a|$ is the average absolute intercept for a set of regressions; R^2 is the average adjusted R^2; $s(a)$ is the average standard error of the intercepts; and $SR(a)$ is the Sharpe ratio for the intercepts. With 25 portfolios and 245 monthly returns, critical values of the GRS statistic for all models are: 90%: 1.41; 95%: 1.56; 97.5%: 1.69; 99%: 1.86; and 99.9%: 2.25.

$a = \frac{1}{25}\sum_{i=1}^{25}|a_i|$

	Global factors								Local factors							
	5 × 5					4 × 5			5 × 5					4 × 5		
	GRS	$\|a\|$	R^2	$s(a)$	$SR(a)$	GRS	$\|a\|$	$SR(a)$	GRS	$\|a\|$	R^2	$s(a)$	$SR(a)$	GRS	$\|a\|$	$SR(a)$
Global																
CAPM	4.07	0.21	0.81	0.13	0.68	1.72	0.17	0.39								
Three-factor	3.62	0.12	0.95	0.07	0.66	2.19	0.09	0.45								
Four-factor	3.22	0.11	0.95	0.07	0.64	1.82	0.07	0.42								
North America		Too high (positive)														
CAPM	3.25	0.40	0.62	0.23	0.61	1.77	0.37	0.40	3.00	0.23	0.73	0.19	0.59	1.41	0.19	0.36
Three-factor	2.95	0.39	0.74	0.19	0.59	2.16	0.36	0.45	2.88	0.13	0.93	0.10	0.59	1.55	0.10	0.38
Four-factor	2.40	0.41	0.75	0.19	0.55	1.74	0.39	0.41	2.57	0.12	0.93	0.10	0.56	1.25	0.08	0.35
Europe																
CAPM	1.65	0.24	0.66	0.20	0.43	1.20	0.23	0.33	1.63	0.20	0.80	0.15	0.43	1.19	0.17	0.33
Three-factor	1.43	0.13	0.76	0.17	0.41	0.84	0.11	0.28	1.23	0.09	0.94	0.09	0.38	1.13	0.08	0.33
Four-factor	1.28	0.10	0.76	0.18	0.40	0.59	0.08	0.24	1.07	0.07	0.94	0.09	0.38	0.94	0.06	0.31
Japan		Too low (negative)														
CAPM	1.48	0.49	0.29	0.39	0.41	1.56	0.52	0.37	1.11	0.18	0.78	0.21	0.35	1.12	0.18	0.31
Three-factor	1.27	0.69	0.36	0.37	0.39	1.31	0.70	0.35	0.88	0.11	0.93	0.12	0.32	0.99	0.10	0.30
Four-factor	1.19	0.63	0.36	0.38	0.39	1.19	0.66	0.34	0.86	0.10	0.93	0.12	0.32	0.96	0.09	0.30
Asia Pacific																
CAPM	2.84	0.41	0.49	0.33	0.57	1.52	0.39	0.37	2.85	0.23	0.78	0.22	0.57	1.40	0.19	0.36
Three-factor	2.50	0.26	0.56	0.32	0.55	1.25	0.24	0.34	2.59	0.22	0.89	0.16	0.56	1.83	0.20	0.41
Four-factor	2.08	0.24	0.56	0.32	0.51	0.90	0.21	0.30	2.22	0.19	0.89	0.16	0.53	1.47	0.17	0.38

Models perform poorly
⇒ NOT integrated

Intercepts from Time Series Regressions

cannot explain the low return on small-cap

Table 4
Intercepts from CAPM, three-factor (1), and four-factor (2) regressions to explain monthly excess returns on portfolios from 5 × 5 sorts on size and B/M, November 1990 to March 2011.

The regressions use the CAPM, three-factor (1), and four-factor (2) models with global and local factors to explain the excess returns on Global, North American, European, Japanese, and Asia Pacific portfolios formed from independent size and B/M sorts. The table reports intercepts, a, and t-statistics, $t(a)$, for the intercepts.

	a					$t(a)$				
	Low	2	3	4	High	Low	2	3	4	High
Global size-B/M returns regressed on global factors										
CAPM										
Small	−0.41	0.01	0.33	0.44	0.75	−1.81	0.07	1.91	2.81	4.77
2	−0.41	−0.01	0.17	0.29	0.39	−2.09	−0.10	1.25	2.36	2.65
3	−0.31	−0.08	0.09	0.16	0.32	−1.90	−0.54	0.82	1.36	2.40
4	−0.15	−0.01	0.08	0.19	0.26	−0.98	−0.11	0.97	1.75	2.00
Big	−0.14	−0.06	0.06	0.11	0.04	−1.26	−0.90	0.90	1.24	0.25
Three-factor										
Small	−0.32	0.00	0.23	0.22	0.44	−3.15	0.03	2.70	3.28	6.08
2	−0.30	−0.04	0.03	−0.00	−0.00	−3.77	−0.59	0.47	−0.02	−0.03
3	−0.13	−0.09	−0.10	−0.14	−0.06	−1.71	−1.28	−1.42	−2.15	−0.94
4	0.07	−0.08	−0.10	−0.08	−0.12	0.82	−1.12	−1.55	−1.17	−1.75
Big	0.18	0.00	−0.04	−0.07	−0.26	3.11	0.04	−0.76	−1.14	−3.06
Four-factor										
Small	−0.33	0.01	0.22	0.21	0.41	−3.16	0.14	2.52	3.09	5.59
2	−0.22	0.02	0.03	0.02	0.01	−2.88	0.33	0.51	0.46	0.19
3	−0.08	−0.09	−0.06	−0.09	−0.05	−1.13	−1.30	−0.79	−1.36	−0.71
4	0.06	−0.04	−0.08	−0.03	−0.07	0.74	−0.57	−1.18	−0.41	−1.01
Big	0.21	−0.03	−0.02	−0.07	−0.15	3.57	−0.56	−0.38	−1.14	−1.89

	a					$t(a)$				
	Low	2	3	4	High	Low	2	3	4	High
North American size-B/M returns regressed on North American factors										
Three-factor										
Small	−0.45	−0.15	0.17	0.11	0.38	−2.75	−1.16	1.58	1.37	4.43
2	−0.45	−0.14	0.02	−0.01	−0.02	−3.71	−1.39	0.26	−0.12	−0.25
3	0.13	−0.18	0.01	−0.04	0.06	1.07	−1.64	0.12	−0.44	0.72
4	0.14	−0.05	0.05	−0.03	0.01	1.08	−0.46	0.46	−0.32	0.07
Big	0.15	−0.00	−0.08	−0.09	−0.34	2.05	−0.00	−0.97	−0.99	−3.20
Four-factor										
Small	−0.44	−0.13	0.17	0.13	0.35	−2.67	−0.94	1.52	1.53	4.03
2	−0.33	−0.12	0.02	0.04	0.00	−2.91	−1.15	0.24	0.55	0.02
3	0.07	−0.14	0.07	0.02	0.07	0.58	−1.29	0.71	0.23	0.87
4	0.11	−0.00	0.07	0.00	0.05	0.82	−0.04	0.64	0.03	0.65
Big	0.17	−0.01	−0.04	−0.06	−0.27	2.23	−0.07	−0.52	−0.66	−2.59
European size-B/M Returns regressed on European factors										
Three-factor										
Small	−0.32	−0.05	0.01	0.10	0.20	−2.63	−0.55	0.13	1.45	2.97
2	−0.12	−0.05	−0.05	0.09	0.06	−0.90	−0.59	−0.61	1.29	0.91
3	−0.05	0.04	−0.04	−0.15	−0.01	−0.42	0.46	−0.42	−1.74	−0.11
4	0.09	0.03	−0.01	−0.17	−0.08	0.82	0.35	−0.09	−1.90	−0.86
Big	0.10	0.07	0.04	0.00	−0.27	1.22	0.80	0.61	0.04	−2.23
Japanese size-B/M returns regressed on Japanese factors										
Three-factor										
Small	0.15	0.09	0.17	0.17	0.18	0.77	0.61	1.18	1.77	1.87
2	−0.10	−0.16	−0.03	0.05	−0.07	−0.66	−1.41	−0.26	0.62	−1.05
3	−0.05	−0.14	−0.21	−0.18	0.01	−0.32	−1.12	−2.07	−1.94	0.09
4	−0.14	−0.02	−0.17	−0.08	−0.12	−0.94	−0.13	−1.40	−0.72	−1.24
Big	0.09	−0.03	−0.12	0.08	0.11	0.82	−0.25	−1.07	0.60	0.59
Asia Pacific size-B/M returns regressed on Asia Pacific factors										
Three-factor										
Small	−0.10	−0.02	0.22	0.41	0.76	−0.44	−0.10	1.56	3.07	5.48
2	−0.39	−0.22	−0.03	−0.06	−0.12	−2.27	−1.58	−0.26	−0.45	−0.87
3	−0.47	0.15	0.16	0.14	−0.33	−2.61	0.89	0.99	0.81	−1.75
4	0.25	0.32	−0.02	0.12	−0.25	1.52	1.98	−0.10	0.66	−1.37
Big	0.11	0.20	0.03	−0.31	−0.36	0.75	1.67	0.26	−2.54	−1.80