

Empirical Asset Pricing

Classes 5 & 6: The Cross-Section of Expected Stock Returns

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What Explains SMB and HML?

- Unlike the market portfolio, the Size and Value portfolios are empirically motivated. If we think of them as risk premiums, then we need to understand the *real, macroeconomic, aggregate, nondiversifiable* risk that is proxied by the SMB and HML portfolios.
- In particular, why are investors so concerned about holding stocks that do badly when the SMB and HML portfolios do badly, even though the market does not fall? We know that small stocks are riskier because they have higher betas. The reward demanded for holding small stocks, however, is larger than what can be justified by the CAPM. Similarly, after controlling for the CAPM, why do investors still consider value stocks risky and demand an additional premium?
- We care because there are prevalent usages of size and value as risk factors. Index funds and ETFs are being offered based on the three factor model. Nevertheless, we know very little about the nature of these factors: Are they risk factors? If so, what risk? If not, then what are they?

Explanations from Various Camps

- Rational Camp: HML and SMB contain information above and beyond that in the market return for forecasting GDP growth. Proxies for variables that forecast time-varying investment opportunities or time-varying risk aversion.
- The Behavioral Camp: Expectational errors made by investors.
- The Critics: Survival bias and Data snooping

Port	Portfolio Results				Regression Results			
	Z	Rets	MV	B/M	Rets = $b_1 + b_2*Z + b_3*MV + b_4*B/M$			
Panel A: NYSE-AMEX Firms								
1	0.84	0.48	3.99	0.77	Predicted: (+)	(?)	(-)	(+)
2	1.93	0.90	5.01	0.97				
3	2.42	1.21	5.20	0.97	1.06	0.03		
4	2.81	1.34	5.13	0.92	(2.75)	(1.59)		
5	3.19	1.35	5.21	0.87	1.24		-0.02	
6	3.60	1.34	5.11	0.82	(2.38)		(-0.36)	
7	4.12	1.49	5.22	0.73	0.89			0.32
8	4.85	1.42	5.26	0.63	(2.42)			(3.26)
9	6.02	1.34	5.39	0.56	0.44	0.06	0.02	0.44
10	11.41	1.07	5.36	0.38	(0.74)	(3.37)	(0.32)	(4.59)
Panel B: Nasdaq Firms								
1	-0.72	0.17	1.88	0.77	Predicted: (+)	(?)	(-)	(+)
2	1.57	0.63	2.50	1.01				
3	2.37	0.87	2.82	1.06	0.81	-0.02		
4	2.96	1.02	2.99	1.02	(2.10)	(-2.62)		
5	3.53	0.96	3.23	0.89	0.92		-0.08	
6	4.19	1.02	3.38	0.80	(2.14)		(-1.22)	
7	5.03	0.92	3.53	0.68	0.08			0.79
8	6.51	1.04	3.68	0.55	(0.18)			(5.97)
9	9.79	0.64	3.86	0.44	-0.14	-0.01	0.07	0.87
10	33.43	0.18	3.74	0.31	(-0.25)	(-1.14)	(1.03)	(6.58)

La Porta, Lakonishok, Shleifer and Vishny (1997)

BM	Glamour		Value		Mean Difference 10-1	<i>t</i> -Stat for Mean Difference 10-1
	1	2	9	10		
Panel A: Event Returns						
Q01-Q04	-0.00472	0.00772	0.03200	0.03532	0.04004	5.65
Q05-Q08	-0.00428	0.00688	0.02828	0.03012	0.03440	7.14
Q09-Q12	0.00312	0.00796	0.02492	0.03136	0.02824	5.12
Q13-Q16	0.00804	0.00812	0.02176	0.02644	0.01840	3.67
Q17-Q20	0.00424	0.01024	0.01368	0.02432	0.02008	4.49
Panel C: Annual Returns						
YR1	0.09254	0.14811	0.22534	0.21547	0.12292	3.84
YR2	0.09284	0.14590	0.20085	0.21971	0.12686	3.88
YR3	0.11979	0.14835	0.24195	0.24496	0.12517	4.27
YR4	0.13063	0.16836	0.23149	0.25141	0.12078	3.82
YR5	0.12274	0.17032	0.22329	0.23518	0.11244	3.11



"A million monkeys banging on a million typewriters for a million years will eventually reproduce the entire works of Shakespeare."

Cross-Sectional Estimations of Factor Risk Premiums

- Stock-market liquidity: Pastor and Stambaugh (2003).
- VIX: Ang, Hodrick, Xing, and Zhang (2006).
- Funding liquidity: Pan, Hu, and Wang (2013).

Pastor and Stambaugh (2003)

TABLE 2
DETERMINANTS OF PREDICTED LIQUIDITY BETAS

	AUGUST 1962 THROUGH		
	December 1998	December 1983	December 1968
Intercept	-1.79 (-6.75)	-4.39 (-12.94)	-2.75 (-2.95)
Historical beta	2.30 (9.97)	3.75 (10.87)	9.18 (9.99)
Average liquidity	-.87 (-4.12)	-.02 (-.08)	-.48 (-.61)
Average volume	1.54 (3.29)	-3.37 (-5.03)	.07 (.05)
Cumulative return	-.04 (-.14)	1.00 (2.86)	.93 (.86)
Return volatility	-.24 (-1.60)	-1.13 (-3.39)	-2.61 (-2.25)
Price	.59 (1.85)	7.51 (15.00)	4.32 (3.38)
Shares outstanding	-1.43 (-3.37)	.67 (1.26)	-.69 (-.54)

Pastor and Stambaugh (2003)

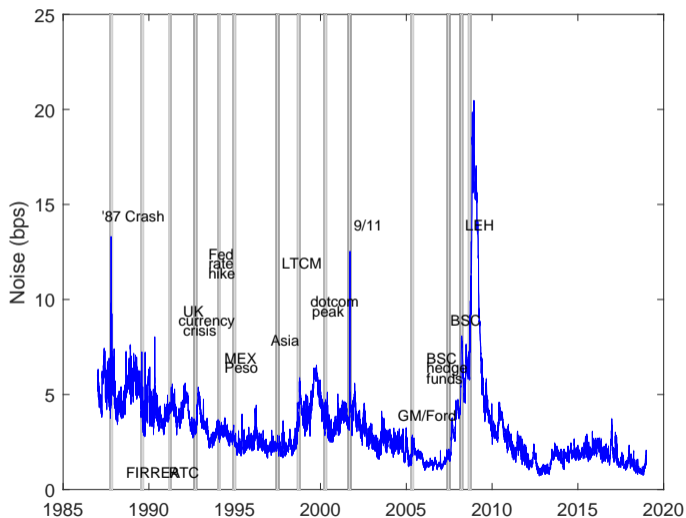
TABLE 3
PROPERTIES OF PORTFOLIOS SORTED ON PREDICTED LIQUIDITY BETAS

	DECILE PORTFOLIO										
	1	2	3	4	5	6	7	8	9	10	10-1
A. Postranking Liquidity Betas											
Jan. 1966–Dec. 1999	-5.75 (-2.22)	-6.54 (-2.98)	-4.66 (-2.59)	-3.16 (-2.18)	.90 (.69)	-.63 (-.54)	-.86 (-.68)	.68 (.52)	2.44 (1.77)	2.48 (1.35)	8.23 (2.37)
Jan. 1966–Dec. 1982	-7.28 (-1.84)	-8.29 (-2.54)	-3.47 (-1.19)	-3.15 (-1.36)	2.58 (1.23)	-.34 (-.17)	-.47 (-.22)	.73 (.33)	-2.51 (-1.10)	4.19 (1.38)	11.47 (2.06)
Jan. 1983–Dec. 1999	-3.00 (-.85)	-4.27 (-1.37)	-5.09 (-2.12)	-2.36 (-1.22)	-1.10 (-.63)	-.84 (-.57)	-1.60 (-1.06)	1.94 (1.22)	5.67 (3.23)	.85 (.36)	3.85 (.84)
B. Additional Properties, January 1966–December 1999											
Market cap	2.83	5.90	8.30	7.65	10.67	16.61	15.99	16.02	16.05	14.28	
Liquidity	-.46	-.16	-.10	-.15	-.08	-.07	-.03	-.03	-.04	-.10	
MKT beta	1.24 (37.70)	1.21 (44.61)	1.09 (48.31)	1.05 (56.83)	1.04 (62.83)	1.03 (68.89)	1.00 (62.56)	1.01 (60.75)	.98 (55.76)	.94 (40.75)	-.30 (-6.85)
SMB beta	.70 (14.47)	.31 (7.64)	.05 (1.61)	.01 (.26)	-.09 (-3.51)	-.12 (-5.63)	-.09 (-5.04)	-.09 (-3.82)	-.12 (-4.76)	.05 (1.36)	-.65 (-10.14)
HML beta	.07 (1.31)	.19 (4.36)	.23 (6.45)	.20 (6.69)	.11 (4.02)	.14 (5.68)	.08 (3.07)	-.00 (-.06)	-.01 (-.37)	-.34 (-9.04)	-.40 (-5.74)
MOM beta	-.06 (-2.43)	-.10 (-5.35)	-.07 (-4.29)	-.03 (-2.19)	-.03 (-2.51)	-.01 (-.72)	.01 (.53)	-.01 (-.72)	.03 (2.72)	.05 (3.02)	.11 (3.41)

Ang, Hodrick, Xing, and Zhang (2006)

Rank	Mean	Std. Dev.	% Mkt Share	Size	B/M	CAPM Alpha	FF-3 Alpha	Factor Loadings			
								Pre-Formation $\beta_{\Delta VIX}$	Pre-Formation β_{FVIX}	Next Month Post-Formation $\beta_{\Delta VIX}$	Full Sample Post-Formation β_{FVIX}
1	1.64	5.53	9.4%	3.70	0.89	0.27 [1.66]	0.30 [1.77]	-2.09	-2.00	-0.033	-5.06 [-4.06]
2	1.39	4.43	28.7%	4.77	0.73	0.18 [1.82]	0.09 [1.18]	-0.46	-0.42	-0.014	-2.72 [-2.64]
3	1.36	4.40	30.4%	4.77	0.76	0.13 [1.32]	0.08 [1.00]	0.03	0.08	0.005	-1.55 [-2.86]
4	1.21	4.79	24.0%	4.76	0.73	-0.08 [-0.87]	-0.06 [-0.65]	0.54	0.62	0.015	3.62 [4.53]
5	0.60	6.55	7.4%	3.73	0.89	-0.88 [-3.42]	-0.53 [-2.88]	2.18	2.31	0.018	8.07 [5.32]
5-1	-1.04 [-3.90]					-1.15 [-3.54]	-0.83 [-2.93]				
Joint test p -value						0.01	0.03				0.00

Pan, Hu, and Wang (2013)



rank			Pre Formation			Post Formation					alpha (%)		
	exret (%)	ret (%)	Δ Noise β^N	Mkt β^M	Adj-R2 (%)	Δ Noise β^N	Mkt β^M	Adj-R2 (%)	Δ Noise $\beta^N + \text{lag}$	Mkt $\beta^M + \text{lag}$	Adj-R2 (%)	no lag β	with lag β
1	0.95 [3.51]	1.20 [4.39]	-2.96 [-42.68]	0.55 [33.62]	36.28	-0.64 [-5.44]	0.49 [10.67]	52.77	-1.00 [-5.53]	0.55 [9.71]	55.19	0.01 [0.05]	0.05 [0.20]
2	0.60 [3.50]	0.85 [4.88]	-1.20 [-41.74]	0.37 [35.01]	34.26	-0.41 [-3.81]	0.33 [11.14]	58.76	-0.55 [-4.10]	0.39 [10.22]	61.28	-0.01 [-0.08]	0.03 [0.15]
3	0.48 [3.49]	0.72 [5.24]	-0.72 [-36.86]	0.28 [31.47]	33.23	-0.25 [-2.53]	0.26 [10.53]	54.45	-0.31 [-2.09]	0.32 [10.99]	57.79	0.04 [0.29]	0.05 [0.36]
4	0.43 [3.39]	0.67 [5.26]	-0.47 [-28.51]	0.25 [32.13]	32.69	-0.28 [-3.04]	0.23 [9.81]	54.46	-0.36 [-2.39]	0.29 [9.24]	58.50	-0.01 [-0.05]	0.01 [0.07]
5	0.34 [3.01]	0.58 [5.12]	-0.29 [-19.16]	0.22 [31.25]	31.42	-0.30 [-3.31]	0.20 [9.20]	52.62	-0.36 [-2.43]	0.25 [8.40]	56.83	-0.07 [-0.63]	-0.04 [-0.37]
6	0.38 [3.76]	0.63 [6.02]	-0.14 [-9.14]	0.21 [35.25]	28.88	-0.25 [-3.16]	0.19 [9.48]	56.95	-0.34 [-2.61]	0.24 [8.98]	61.70	0.01 [0.14]	0.03 [0.27]
7	0.29 [2.87]	0.53 [5.21]	0.02 [1.01]	0.21 [35.28]	27.10	-0.24 [-3.17]	0.19 [9.33]	56.44	-0.18 [-1.69]	0.24 [8.38]	59.39	-0.07 [-0.70]	-0.02 [-0.15]
8	0.38 [3.51]	0.62 [5.68]	0.24 [10.02]	0.24 [36.02]	26.41	-0.20 [-2.17]	0.21 [9.76]	55.24	-0.04 [-0.35]	0.26 [9.54]	57.49	0.03 [0.30]	0.10 [0.94]
9	0.36 [2.75]	0.60 [4.59]	0.63 [17.09]	0.29 [33.47]	26.13	-0.08 [-0.89]	0.26 [9.31]	55.41	0.08 [0.57]	0.31 [9.32]	56.58	0.03 [0.23]	0.07 [0.53]
10	0.23 [1.21]	0.47 [2.49]	1.94 [25.49]	0.40 [23.18]	27.59	0.15 [0.62]	0.33 [6.76]	35.09	0.69 [2.60]	0.43 [8.08]	39.06	0.00 [-0.01]	0.03 [0.16]

Panel B: Developed Countries Only

Rank	exret (%)	Two-Factor Model			CAPM		One Factor	
		Δ Noise β^N	Market β^M	Adj-R2 (%)	alpha (%)	beta	alpha (%)	Δ Noise beta
1	0.53 [2.81]	-0.78 [-3.45]	0.13 [2.06]	11.07	-0.15 [-0.79]	0.19 [2.87]	0.43 [1.98]	-1.01 [-4.33]
2	0.40 [2.35]	-0.69 [-2.51]	0.15 [2.95]	14.78	-0.25 [-1.50]	0.21 [3.37]	0.29 [1.48]	-0.96 [-3.14]
3	0.25 [1.56]	-0.40 [-1.47]	0.12 [2.30]	8.00	-0.16 [-1.00]	0.15 [2.67]	0.17 [0.95]	-0.61 [-2.08]
4	0.23 [1.47]	-0.18 [-0.59]	0.05 [1.01]	1.48	0.05 [0.29]	0.07 [1.26]	0.19 [1.04]	-0.26 [-0.84]
5	0.03 [0.21]	-0.06 [-0.27]	0.02 [0.40]	0.22	-0.05 [-0.32]	0.03 [0.66]	0.01 [0.08]	-0.09 [-0.40]
6	0.00 [0.01]	0.47 [2.04]	0.02 [0.27]	1.73	0.30 [1.63]	-0.01 [-0.19]	0.01 [0.04]	0.44 [2.15]

Cross-Sectional Patterns

- Short-term reversal: Lehmann (1990) and Jegadeesh (1990).
- Long-term reversal: DeBondt and Thaler (1985)
- Medium-term momentum: Jegadeesh and Titman (1993).
- Post earnings announcement drift: Bernard and Thomas (1989).
- The accrual and cash flow components of earnings: Sloan (1996).
- Stock trading volume: Gervais, Kaniel, and Mingelgrin (2001).
- Dispersion in analysts' earnings forecasts: Diether, Malloy, and Scherbina (2002).
- Information in option trading volume: Pan and Poteshman (2006).
- The economic link between customers and suppliers: Cohen and Frazzini (2008).

DeBondt and Thaler (1985)

Average of 46 Yearly Replications
Starting Every January Between 1933 and 1978
Length of Formation Period: Five Years

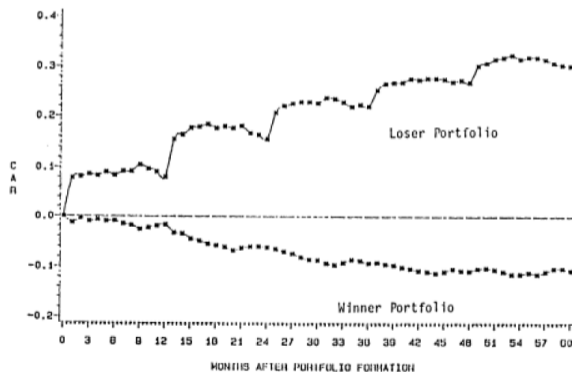
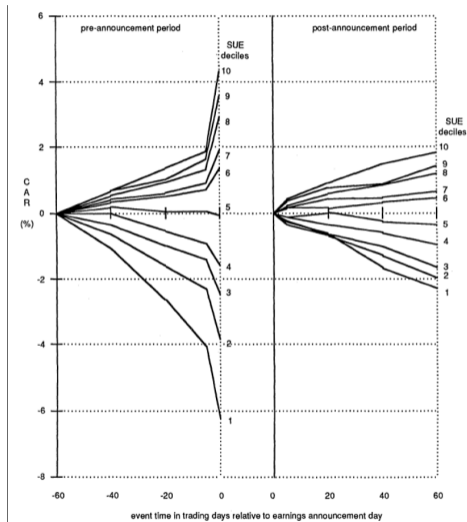


Figure 3. Cumulative Average Residuals for Winner and Loser Portfolios of 35 Stocks (1-60 months into the test period)

Bernard and Thomas (1989)

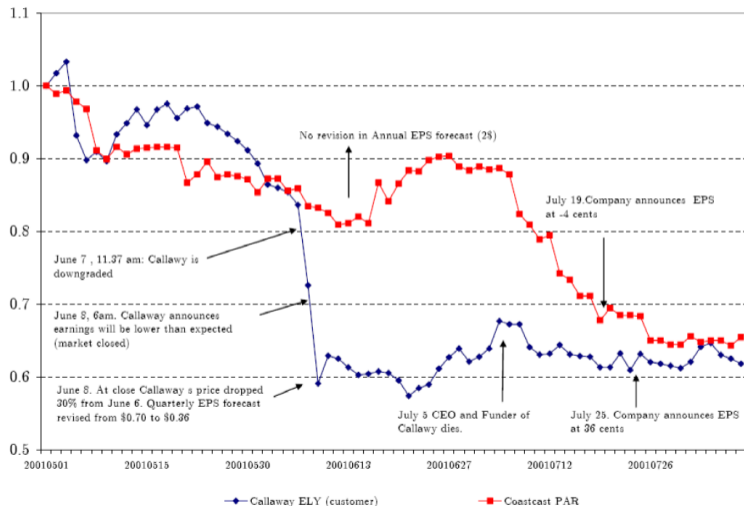


Pan and Poteshman (2006)

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

Pan and Poteshman (2006)



Cohen and Fazzini (2008)

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

Daily Currency Returns from 2000 through 2016

std (%)	GBP	EUR	AUD	CAD	CNY	INR	JPY	CHF	THB	RUB
	0.60	0.63	0.82	0.59	0.10	0.38	0.64	0.70	0.36	0.77
corr (%)	GBP	EUR	AUD	CAD	CNY	INR	JPY	CHF	THB	RUB
GBP		64.4	53.1	45.3	12.9	25.2	12.3	49.7	18.6	23.9
EUR	64.4		55.3	46.0	10.4	23.3	27.5	78.2	21.1	25.7
AUD	53.1	55.3		62.3	12.8	33.9	2.9	39.2	23.4	32.8
CAD	45.3	46.0	62.3		9.4	27.0	1.0	32.7	19.9	33.3
CNY	12.9	10.4	12.8	9.4		16.8	5.6	8.8	16.1	10.7
INR	25.2	23.3	33.9	27.0	16.8		-4.0	15.1	25.5	26.6
JPY	12.3	27.5	2.9	1.0	5.6	-4.0		37.5	17.6	-1.1
CHF	49.7	78.2	39.2	32.7	8.8	15.1	37.5		17.7	19.3
THB	18.6	21.1	23.4	19.9	16.1	25.5	17.6	17.7		15.9
RUB	23.9	25.7	32.8	33.3	10.7	26.6	-1.1	19.3	15.9	

The First Three PCs

The first three PC's of currency returns

	PC 1	PC 2	PC3
E/sum(E)	44.32%	17.07%	12.27%
GBP	0.3502	0.0715	0.1382
EUR	0.4191	0.2531	0.0037
AUD	0.5410	-0.2512	0.4398
CAD	0.3259	-0.1870	0.1890
CNY	0.0122	-0.0032	-0.0046
INR	0.1154	-0.1104	0.0113
JPY	0.1226	0.5569	-0.3908
CHF	0.4100	0.4488	-0.1497
THB	0.0882	0.0084	-0.0390
RUB	0.3138	-0.5558	-0.7582

The First Three PCs

The first three PC's of currency returns			
	PC 1	PC 2	PC3
E/sum(E)	54.03%	20.25%	10.10%
GBP	0.3748	-0.0312	0.2595
EUR	0.4538	0.1878	0.2925
AUD	0.5621	-0.4869	-0.4163
CAD	0.3324	-0.2946	-0.1879
JPY	0.1499	0.6699	-0.7030
CHF	0.4524	0.4371	0.3799

Fama-French 25 Portfolios			
	PC 1	PC 2	PC3
E/sum(E)	83.84%	4.39%	3.19%
A1	0.2874	-0.5850	-0.6434
A2	0.2456	-0.2909	0.4001
A3	0.2378	-0.1526	0.0693
A4	0.2225	-0.1552	0.1332
A5	0.2468	-0.1586	0.0062
B1	0.2048	-0.1685	0.2221
B2	0.2013	-0.0520	0.2160
B3	0.1981	-0.0093	0.1173
B4	0.2033	0.0110	0.0517
B5	0.2353	-0.0044	-0.0768
C1	0.1938	-0.0751	0.1897
C2	0.1732	0.0673	0.1030
C3	0.1765	0.1135	0.0537
C4	0.1873	0.1154	0.0207
C5	0.2283	0.1122	-0.1330
D1	0.1555	0.0565	0.1347
D2	0.1606	0.1471	0.0868
D3	0.1707	0.1824	0.0360
D4	0.1810	0.1743	-0.0947
D5	0.2289	0.2343	-0.1251
E1	0.1264	0.1461	0.0572
E2	0.1298	0.2066	0.0048
E3	0.1380	0.2427	-0.0676
E4	0.1662	0.2704	-0.1142
E5	0.2050	0.2846	-0.3807

Momentum 25 Portfolios			
	PC 1	PC 2	PC3
E/sum(E)	82.40%	5.53%	4.06%
A1	0.2791	0.0183	0.4184
A2	0.2498	-0.0775	0.3119
A3	0.2311	-0.1137	0.2692
A4	0.2267	-0.2113	0.1814
A5	0.2150	-0.3085	0.0656
B1	0.2629	0.1010	0.1670
B2	0.2212	-0.0021	0.1058
B3	0.1945	-0.0576	0.0161
B4	0.1906	-0.1614	-0.0098
B5	0.1963	-0.2603	-0.1152
C1	0.2480	0.2102	0.0695
C2	0.2057	0.0630	-0.0203
C3	0.1844	-0.0147	-0.0639
C4	0.1633	-0.0974	-0.1426
C5	0.1654	-0.2323	-0.2459
D1	0.2399	0.2932	-0.0217
D2	0.1898	0.1263	-0.1283
D3	0.1665	0.0267	-0.1472
D4	0.1569	-0.0562	-0.2211
D5	0.1499	-0.2015	-0.3146
E1	0.2049	0.6397	-0.1310
E2	0.1573	0.1926	-0.1621
E3	0.1430	0.0898	-0.2025
E4	0.1228	-0.0192	-0.2724
E5	0.1243	-0.1436	-0.3605