
Cross-Sectional Asset Pricing with Individual Stocks: Betas versus Characteristics

Tarun Chordia, Amit Goyal, and Jay Shanken

Main question

- Are expected returns related to
 - Risk/betas, OR
 - Characteristics

- If both, which is more important?

How to answer?

- Use portfolios
 - Helps mitigate EIV problem
 - Fama and MacBeth (1973)
 - But,
 - Less efficient
 - Ang, Liu, and Schwarz (2010)
 - Method of grouping is important
 - Lewellen, Nagel, and Shanken (2010)

- Use individual securities
 - But, EIV problem

What we do

- Use individual securities
- Correct for EIV bias
 - Litzenberger and Ramaswamy (1979), Shanken (1992), Kim (1995)
- Allow betas to change over time
 - Two year rolling regressions
- Quantify contribution of betas vs characteristics in explaining the cross-section of returns

Methodology

- Two Pass Methodology: Fama-MacBeth
- Time-series regression (TSR)

$$R_{it} = B_{0i} + B_i F_t + \varepsilon_{it}$$

- Cross-sectional regression (CSR)

$$R_t = \gamma_{0t} + \hat{B}_{t-1} \gamma_{1t} + Zcs_{t-1} \gamma_{2t} + \varepsilon_t$$

- Betas are estimated with error

$$\hat{\Gamma}_t \equiv (\hat{\gamma}_{0t}, \hat{\gamma}'_{1t}, \hat{\gamma}'_{2t})'$$

$$\hat{\Gamma}_t = (\hat{X}'_t \hat{X}_t)^{-1} \hat{X}'_t R_t, \text{ where } \hat{X}_t \equiv \left[\mathbf{1}_{N_t} : \hat{B}_{t-1} : Zcs_{t-1} \right]$$

Methodology

- Standard-error correction
 - New formulas to account for conditional betas; extension of Shanken (1992)
 - Matter little in practice for traded factors

- Bias correction

$$\hat{\Gamma}_t^{\text{EIV}} = \left(\hat{X}_t' \hat{X}_t - \sum_{i=1}^{N_t} M' \hat{\Sigma}_{\hat{B}_{it-1}} M \right)^{-1} \hat{X}_t' R_t,$$

where

$$\hat{\Sigma}_{\hat{B}_{it-1}} = Zts'_{it-1} \hat{\Sigma}_{\hat{B}_i^*}^{\text{White}} Zts_{it-1}, \text{ and } M = \begin{bmatrix} \mathbf{0}_{k \times 1} & I_{k \times k} & \mathbf{0}_{k \times k_2} \end{bmatrix},$$

Intuition ...

- For a one-factor model

$$\gamma^{OLS} = \frac{\text{cov}_{cs}(\hat{\beta}_{it}, R_{it})}{\text{var}_{cs}(\hat{\beta}_{it})} = \frac{\text{cov}_{cs}(\beta_{it}, R_{it})}{\text{var}_{cs}(\hat{\beta}_{it})}$$

- The denominator is equal to the cross-sectional variation of betas (this is what we want) plus the cross-sectional variation of beta estimation error (this is what we want to remove). Fortunately

$$\begin{aligned}\text{var}_{cs}(\hat{\beta}_{it}) &= \text{var}_{cs}(\beta_{it}) + \text{var}_{cs}(\hat{\beta}_{it} - \beta_{it}) \\ &= \text{var}_{cs}(\beta_{it}) + \text{var}_{cs}(\sigma_{ei}^2 \Sigma_F^{-1})\end{aligned}$$

$$\gamma^{EIV} = \frac{\text{cov}_{cs}(\beta_{it}, R_{it})}{\text{var}_{cs}(\hat{\beta}_{it}) - \text{var}_{cs}(\sigma_{ei}^2 \Sigma_F^{-1})}$$

Relative importance

- Using average CSR estimates

$$E_{t-1} [R_t] = \hat{\gamma}_0 + E_{t-1}^{\text{beta}} [R_t] + E_{t-1}^{\text{char}} [R_t], \text{ where}$$

$$E_{t-1}^{\text{beta}} [R_t] = \hat{B}_{t-1} \hat{\gamma}_1, \text{ and } E_{t-1}^{\text{char}} [R_t] = Zcs_{t-1} \hat{\gamma}_2$$

- Using cross-sectional variation at time t

$$\%(\text{Betas}) = \text{var}_{cs} \left(E_{t-1}^{\text{beta}} [R_t] \right) / \text{var}_{cs} \left(E_{t-1} [R_t] \right)$$

$$\%(\text{Chars}) = \text{var}_{cs} \left(E_{t-1}^{\text{char}} [R_t] \right) / \text{var}_{cs} \left(E_{t-1} [R_t] \right)$$

Simulation

Number	Actual - Factor Mean				Actual - Truth					
of	Bias		RMSE		Bias		RMSE		FMSE	
stocks	OLS	EIV	OLS	EIV	OLS	EIV	OLS	EIV	OLS	EIV
	Premia on B_{Mkt}									
500	-0.1287	0.0057	0.1503	0.0878	-0.1310	0.0033	0.2207	0.2029	0.1827	0.2092
1,000	-0.1210	0.0050	0.1363	0.0688	-0.1126	0.0134	0.2073	0.1967	0.1772	0.1999
2,500	-0.1310	0.0029	0.1402	0.0521	-0.1326	0.0013	0.2172	0.1953	0.1724	0.1952
5,000	-0.1376	-0.0008	0.1454	0.0462	-0.1415	-0.0047	0.2211	0.1938	0.1706	0.1940
	Premia on B_{SMB}									
500	-0.0682	0.0020	0.0869	0.0651	-0.0708	-0.0006	0.1188	0.1192	0.0923	0.1150
1,000	-0.0612	0.0021	0.0730	0.0458	-0.0614	0.0019	0.1069	0.1067	0.0865	0.1058
2,500	-0.0655	0.0005	0.0723	0.0324	-0.0620	0.0039	0.1033	0.1000	0.0832	0.1008
5,000	-0.0662	0.0008	0.0719	0.0269	-0.0666	0.0004	0.1048	0.0982	0.0818	0.0993
	Premia on B_{HML}									
500	-0.0620	-0.0016	0.0822	0.0684	-0.0570	0.0034	0.1055	0.1133	0.0882	0.1122
1,000	-0.0803	0.0033	0.0905	0.0505	-0.0847	-0.0011	0.1197	0.1064	0.0819	0.1023
2,500	-0.0792	0.0009	0.0853	0.0335	-0.0742	0.0059	0.1076	0.0961	0.0786	0.0968
5,000	-0.0812	0.0003	0.0858	0.0275	-0.0841	-0.0025	0.1136	0.0941	0.0773	0.0950
	Premia on B_{RMW}									
500	-0.1506	0.0059	0.1601	0.0807	-0.1483	0.0083	0.1625	0.1041	0.0668	0.1045
1,000	-0.1335	0.0031	0.1384	0.0457	-0.1320	0.0046	0.1439	0.0810	0.0585	0.0827
2,500	-0.1290	0.0032	0.1326	0.0335	-0.1352	-0.0030	0.1453	0.0756	0.0529	0.0754
5,000	-0.1365	0.0006	0.1391	0.0269	-0.1314	0.0057	0.1410	0.0722	0.0514	0.0721
	Premia on B_{CMA}									
500	-0.0867	0.0051	0.0990	0.0764	-0.0873	0.0045	0.1092	0.1015	0.0650	0.0998
1,000	-0.0930	0.0046	0.1009	0.0541	-0.0956	0.0020	0.1105	0.0813	0.0576	0.0852
2,500	-0.0854	0.0040	0.0905	0.0348	-0.0828	0.0066	0.0982	0.0749	0.0529	0.0738
5,000	-0.0911	0.0016	0.0952	0.0268	-0.0906	0.0022	0.1039	0.0704	0.0512	0.0703

Data

- All common stocks on NYSE, AMEX, and NASDAQ
- Sample: July 1963 to December 2013
- Price greater than \$1 (for CSR)
- Sample of all stocks and non-microcap stocks (>20% NYSE percentile)
 - Monthly average of over 3000 stocks with about 1500 non-microcap stocks
- Fama-French (2014) five factor model plus Momentum
 - Mkt, SMB, HML, RMW, CMA
- Characteristics include size, B/M, past six month return (exclude last month), operating profitability and investment
 - Assumed to be available 6 months after fiscal year-end
 - Winsorized at the 99th and 1st percentiles

Data

Panel A: Cross-sectional statistics					
	B_{Mkt}	B_{SMB}	B_{HML}	B_{RMW}	B_{CMA}
Mean	0.944	0.754	0.173	-0.085	-0.009
Sdev	0.512	0.750	0.879	0.982	0.968
10%	0.299	-0.118	-0.857	-1.271	-1.115
25%	0.593	0.235	-0.295	-0.569	-0.499
Median	0.930	0.684	0.186	-0.011	0.008
75%	1.273	1.201	0.655	0.482	0.498
90%	1.599	1.729	1.171	0.993	1.072

Panel B: Correlations									
	B_{SMB}	B_{HML}	B_{RMW}	B_{CMA}	Sz	B/M	Ret6	Profit	Invest
B_{Mkt}	0.430	0.047	-0.068	-0.058	0.276	-0.200	-0.038	0.024	0.115
B_{SMB}		0.119	0.043	0.011	-0.429	-0.041	-0.047	-0.147	-0.002
B_{HML}			0.422	-0.244	-0.057	0.327	0.026	0.034	-0.103
B_{RMW}				0.111	0.040	0.068	0.060	0.255	0.019
B_{CMA}					-0.093	0.007	0.031	-0.043	-0.120
Sz						-0.307	0.143	0.252	0.140
B/M							-0.252	-0.095	-0.174
Ret6								0.060	-0.050
Profit									0.268

	1-factor		3-factor		4-factor		5-factor		6-factor	
	OLS	EIV	OLS	EIV	OLS	EIV	OLS	EIV	OLS	EIV
Panel A : With fewer characteristics in CSR										
Cnst	0.694	0.674	0.676	0.600	0.679	0.643	0.666	0.537	0.662	0.589
	(5.31)	(5.20)	(5.37)	(4.89)	(5.47)	(5.26)	(5.35)	(4.23)	(5.37)	(4.80)
B _{Mkt}	0.062	0.081	0.105	0.274	0.099	0.221	0.119	0.418	0.117	0.329
	(0.38)	(0.39)	(0.74)	(1.49)	(0.71)	(1.23)	(0.85)	(2.16)	(0.84)	(1.79)
B _{SMB}			-0.097	-0.293	-0.099	-0.280	-0.086	-0.319	-0.081	-0.292
			(-1.52)	(-2.21)	(-1.58)	(-2.10)	(-1.40)	(-2.44)	(-1.33)	(-2.18)
B _{HML}			0.067	0.094	0.045	0.037	0.046	-0.059	0.024	-0.084
			(0.87)	(0.76)	(0.61)	(0.29)	(0.63)	(-0.43)	(0.33)	(-0.67)
B _{MOM}					-0.046	-0.115			-0.038	0.090
					(-0.43)	(-0.51)			(-0.37)	(0.42)
B _{RMW}							0.093	0.314	0.097	0.258
							(1.64)	(2.46)	(1.72)	(2.34)
B _{CMA}							0.073	0.220	0.069	0.182
							(1.43)	(2.33)	(1.38)	(2.00)
Sz	-0.087	-0.091	-0.106	-0.158	-0.103	-0.143	-0.104	-0.168	-0.102	-0.154
	(-2.15)	(-2.17)	(-3.01)	(-4.38)	(-2.95)	(-4.05)	(-3.01)	(-4.68)	(-2.96)	(-4.36)
B/M	0.318	0.315	0.297	0.260	0.299	0.268	0.297	0.272	0.298	0.285
	(6.04)	(6.24)	(6.34)	(5.85)	(6.66)	(6.20)	(6.55)	(6.23)	(6.77)	(6.69)
Ret6	1.579	1.585	1.595	1.574	1.586	1.566	1.570	1.551	1.562	1.551
	(9.85)	(10.24)	(10.31)	(10.37)	(10.47)	(10.72)	(10.28)	(10.33)	(10.38)	(10.76)
% Betas	0.5	0.8	3.5	12.0	3.2	10.6	9.0	30.5	8.8	23.6
% Chars	103.1	104.2	99.7	110.0	100.7	109.1	93.4	97.3	94.0	101.8
% Diff	102.5	103.4	96.2	98.1	97.5	98.5	84.4	66.8	85.1	78.3
	(97.5, 104.9)	(96.9, 106.4)	(77.7, 108.1)	(68.6, 117.8)	(85.0, 108.8)	(77.6, 118.8)	(54.9, 104.2)	(35.8, 103.6)	(62.0, 104.0)	(54.5, 109.0)

	1-factor		3-factor		4-factor		5-factor		6-factor	
	OLS	EIV	OLS	EIV	OLS	EIV	OLS	EIV	OLS	EIV
Panel B : With all characteristics in CSR										
Cnst	0.641	0.595	0.633	0.531	0.633	0.585	0.623	0.498	0.619	0.543
	(4.90)	(4.58)	(5.04)	(4.32)	(5.10)	(4.75)	(5.01)	(3.96)	(5.01)	(4.35)
B _{Mkt}	0.154	0.202	0.177	0.365	0.178	0.324	0.191	0.469	0.191	0.421
	(0.96)	(0.98)	(1.25)	(1.95)	(1.27)	(1.77)	(1.36)	(2.36)	(1.37)	(2.21)
B _{SMB}			-0.066	-0.247	-0.069	-0.248	-0.058	-0.270	-0.055	-0.267
			(-1.04)	(-1.83)	(-1.12)	(-1.82)	(-0.95)	(-1.99)	(-0.92)	(-1.89)
B _{HML}			0.034	0.073	0.014	0.012	0.015	-0.073	-0.004	-0.131
			(0.45)	(0.58)	(0.19)	(0.09)	(0.21)	(-0.51)	(-0.05)	(-1.00)
B _{MOM}					0.004	0.049			0.004	0.229
					(0.03)	(0.21)			(0.04)	(0.99)
B _{RMW}							0.069	0.244	0.070	0.240
							(1.25)	(2.01)	(1.27)	(2.00)
B _{CMA}							0.049	0.166	0.046	0.136
							(0.95)	(1.72)	(0.91)	(1.44)
Sz	-0.105	-0.110	-0.118	-0.168	-0.117	-0.158	-0.117	-0.172	-0.116	-0.168
	(-2.80)	(-2.82)	(-3.57)	(-4.76)	(-3.56)	(-4.56)	(-3.57)	(-4.79)	(-3.55)	(-4.70)
B/M	0.284	0.286	0.266	0.232	0.271	0.250	0.269	0.252	0.271	0.272
	(5.54)	(5.77)	(5.76)	(5.21)	(6.12)	(5.76)	(5.96)	(5.71)	(6.18)	(6.28)
Ret6	1.447	1.460	1.464	1.449	1.455	1.427	1.451	1.442	1.438	1.435
	(8.93)	(9.31)	(9.30)	(9.36)	(9.45)	(9.54)	(9.34)	(9.41)	(9.41)	(9.67)
Profit	0.709	0.704	0.686	0.642	0.691	0.646	0.678	0.600	0.681	0.602
	(7.00)	(7.04)	(7.06)	(6.83)	(7.21)	(6.99)	(7.12)	(6.04)	(7.23)	(6.28)
Invest	-1.245	-1.262	-1.226	-1.211	-1.209	-1.189	-1.188	-1.138	-1.176	-1.155
	(-11.23)	(-11.26)	(-11.45)	(-10.81)	(-11.46)	(-10.68)	(-11.28)	(-10.08)	(-11.25)	(-9.99)
% Betas	2.5	3.5	3.0	9.5	2.8	8.9	5.6	20.1	5.4	20.1
% Chars	105.8	107.9	103.4	111.8	104.8	114.7	98.8	103.3	99.7	107.6
% Diff	103.3	104.4	100.4	102.3	102.0	105.8	93.3	83.1	94.3	87.6
	(102.3, 105.1)	(103.0, 106.5)	(91.8, 108.7)	(86.5, 117.6)	(97.8, 110.3)	(97.1, 121.3)	(77.9, 106.2)	(62.9, 109.7)	(84.1, 106.8)	(70.5, 113.0)

	1-factor		3-factor		4-factor		5-factor		6-factor	
	OLS	EIV	OLS	EIV	OLS	EIV	OLS	EIV	OLS	EIV
Panel A : With fewer characteristics in CSR - non-microcap										
Cnst	0.787	0.790	0.749	0.721	0.791	0.826	0.730	0.682	0.761	0.768
	(5.26)	(5.25)	(5.48)	(5.38)	(5.81)	(5.98)	(5.50)	(5.19)	(5.72)	(5.56)
B _{Mkt}	-0.017	-0.021	0.064	0.143	0.046	0.117	0.098	0.245	0.082	0.208
	(-0.10)	(-0.11)	(0.41)	(0.77)	(0.30)	(0.64)	(0.63)	(1.31)	(0.54)	(1.11)
B _{SMB}			-0.137	-0.252	-0.171	-0.355	-0.124	-0.260	-0.148	-0.328
			(-1.77)	(-1.82)	(-2.30)	(-2.60)	(-1.71)	(-1.95)	(-2.09)	(-2.45)
B _{HML}			0.131	0.186	0.094	0.113	0.086	0.086	0.053	0.021
			(1.51)	(1.63)	(1.13)	(1.00)	(1.06)	(0.73)	(0.66)	(0.18)
B _{MOM}					-0.031	0.029			-0.026	0.052
					(-0.24)	(0.14)			(-0.21)	(0.26)
B _{RMW}							0.141	0.229	0.157	0.277
							(2.21)	(2.31)	(2.48)	(2.81)
B _{CMA}							0.101	0.203	0.089	0.175
							(1.62)	(2.17)	(1.49)	(1.93)
Sz	-0.083	-0.084	-0.116	-0.152	-0.129	-0.190	-0.110	-0.153	-0.122	-0.184
	(-2.06)	(-2.07)	(-3.65)	(-4.18)	(-4.09)	(-5.25)	(-3.50)	(-4.25)	(-3.90)	(-5.11)
B/M	0.189	0.186	0.138	0.097	0.150	0.127	0.151	0.130	0.154	0.144
	(3.27)	(3.31)	(2.78)	(2.01)	(3.24)	(2.87)	(3.17)	(2.79)	(3.37)	(3.25)
Ret6	1.316	1.311	1.317	1.305	1.325	1.339	1.331	1.318	1.316	1.322
	(6.47)	(6.53)	(6.74)	(6.74)	(7.24)	(7.55)	(7.09)	(7.12)	(7.28)	(7.53)
% Betas	0.1	0.1	14.5	25.8	14.1	32.4	25.7	39.8	26.5	44.4
% Chars	99.4	99.2	90.8	97.1	99.1	117.3	77.7	79.5	82.5	91.8
% Diff	99.3	99.1	76.3	71.2	84.9	84.9	52.0	39.7	56.0	47.4
	(86.4, 102.0)	(82.5, 102.3)	(34.6, 106.6)	(20.4, 113.1)	(54.2, 109.6)	(44.9, 120.9)	(7.0, 95.0)	(-1.9, 92.6)	(14.1, 96.7)	(9.1, 99.5)

	1-factor		3-factor		4-factor		5-factor		6-factor	
	OLS	EIV	OLS	EIV	OLS	EIV	OLS	EIV	OLS	EIV
Panel B : With all characteristics in CSR - non-microcap										
Cnst	0.715	0.699	0.693	0.661	0.733	0.765	0.682	0.633	0.712	0.736
	(4.76)	(4.62)	(5.05)	(4.90)	(5.36)	(5.46)	(5.09)	(4.75)	(5.29)	(5.40)
B _{Mkt}	0.092	0.108	0.135	0.206	0.123	0.195	0.159	0.296	0.147	0.251
	(0.54)	(0.54)	(0.85)	(1.09)	(0.80)	(1.04)	(1.03)	(1.56)	(0.97)	(1.34)
B _{SMB}			-0.095	-0.186	-0.131	-0.301	-0.089	-0.209	-0.112	-0.291
			(-1.22)	(-1.29)	(-1.76)	(-2.15)	(-1.21)	(-1.49)	(-1.57)	(-2.11)
B _{HML}			0.082	0.127	0.045	0.053	0.048	0.050	0.014	-0.017
			(0.95)	(1.10)	(0.54)	(0.47)	(0.59)	(0.42)	(0.18)	(-0.14)
B _{MOM}					0.015	0.090			0.013	0.080
					(0.12)	(0.44)			(0.10)	(0.40)
B _{RMW}							0.109	0.191	0.125	0.249
							(1.72)	(1.89)	(1.99)	(2.49)
B _{CMA}							0.076	0.175	0.066	0.145
							(1.22)	(1.83)	(1.10)	(1.57)
Sz	-0.101	-0.102	-0.120	-0.148	-0.135	-0.191	-0.116	-0.151	-0.128	-0.188
	(-2.58)	(-2.58)	(-3.83)	(-3.98)	(-4.31)	(-5.14)	(-3.72)	(-4.03)	(-4.12)	(-5.01)
B/M	0.185	0.185	0.145	0.111	0.161	0.145	0.155	0.131	0.159	0.141
	(3.04)	(3.09)	(2.67)	(2.03)	(3.17)	(2.90)	(2.99)	(2.56)	(3.18)	(2.83)
Ret6	1.272	1.269	1.270	1.257	1.279	1.297	1.282	1.259	1.265	1.269
	(6.25)	(6.33)	(6.48)	(6.47)	(6.96)	(7.28)	(6.79)	(6.76)	(6.96)	(7.15)
Profit	0.659	0.646	0.611	0.558	0.622	0.568	0.554	0.428	0.556	0.414
	(5.04)	(4.94)	(4.87)	(4.42)	(5.15)	(4.76)	(4.72)	(3.57)	(4.84)	(3.50)
Invest	-0.985	-1.003	-0.916	-0.890	-0.899	-0.856	-0.856	-0.802	-0.841	-0.752
	(-7.16)	(-7.34)	(-7.03)	(-6.74)	(-7.09)	(-6.59)	(-6.80)	(-5.99)	(-6.75)	(-5.63)
% Betas	1.6	2.0	6.4	12.1	6.0	18.4	13.7	25.8	13.8	30.9
% Chars	102.8	103.5	94.8	97.0	102.0	115.1	83.4	80.0	87.7	92.1
% Diff	101.2	101.5	88.4	84.9	96.0	96.7	69.7	54.2	73.9	61.2
	(99.8, 103.6)	(100.0, 104.2)	(65.6, 107.2)	(54.0, 112.6)	(85.8, 111.0)	(79.1, 120.5)	(39.7, 100.8)	(22.1, 98.9)	(50.5, 102.7)	(32.9, 105.5)

Time variation in risk premia

- Allow predictability in risk premia with dividend-price ratio, term spread, and default spread as predictive variables x

$$\hat{\gamma}_t = c_0 + c_1'x_{t-1} + v_t$$

- Calculate fitted values

$$\hat{\gamma}_{t-1}^{fit} = \hat{c}_0 + \hat{c}_1'x_{t-1}$$

- Recalculate the contribution numbers as

$$E_{t-1} [R_t] = \hat{\gamma}_0 + E_{t-1}^{\text{beta}} [R_t] + E_{t-1}^{\text{char}} [R_t], \text{ where}$$

$$E_{t-1}^{\text{beta}} [R_t] = \hat{B}_{t-1} \hat{\gamma}_{1t-1}^{fit}, \text{ and } E_{t-1}^{\text{char}} [R_t] = Zcs_{t-1} \hat{\gamma}_{2t-1}^{fit}$$

	1-factor		3-factor		4-factor		5-factor		6-factor	
	OLS	EIV	OLS	EIV	OLS	EIV	OLS	EIV	OLS	EIV
Panel A1 : All stocks, With fewer characteristics in CSR										
Fstat Betas	0.63	0.57	0.97	0.79	1.01	1.04	1.07	0.86	1.36	1.23
	(0.59)	(0.63)	(0.46)	(0.63)	(0.44)	(0.41)	(0.38)	(0.62)	(0.15)	(0.23)
Fstat Chars	2.42	2.12	3.59	4.32	3.58	3.89	3.6	4.12	3.64	3.91
	(0.01)	(0.03)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
% Betas	7.2	8.6	13.0	21.7	14.8	24.4	19.6	39.0	21.2	38.2
% Chars	95.3	94.9	96.8	108.0	93.1	97.5	89.0	89.9	85.5	84.3
% Diff	88.0	86.2	83.8	86.3	78.3	73.1	69.4	51.0	64.3	46.1
	(72.1, 102.3)	(68.1, 102.8)	(71.4, 103.5)	(74.7, 111.7)	(70.2, 100.8)	(64.8, 106.1)	(53.6, 96.5)	(33.3, 88.7)	(53.1, 93.2)	(33.4, 83.6)
Panel A2 : All stocks, With all characteristics in CSR										
Fstat Betas	0.44	0.37	1.03	0.91	1.01	1.06	1.06	1.02	1.33	1.36
	(0.72)	(0.77)	(0.41)	(0.51)	(0.44)	(0.39)	(0.39)	(0.44)	(0.16)	(0.15)
Fstat Chars	2.15	1.98	2.86	3.38	2.88	3.19	2.91	3.37	2.92	3.3
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
% Betas	5.3	6.5	9.5	18.1	11.2	21.3	14.2	28.7	15.7	33.6
% Chars	99.5	99.9	100.7	111.3	97.5	104.3	95.4	100.4	92.0	91.8
% Diff	94.2	93.4	91.2	93.2	86.3	83.0	81.2	71.7	76.3	58.3
	(84.9, 102.9)	(83.0, 103.9)	(84.8, 106.1)	(86.8, 112.9)	(81.7, 101.4)	(77.3, 106.2)	(72.4, 100.7)	(62.4, 102.5)	(70.2, 97.8)	(46.6, 91.9)

	1-factor		3-factor		4-factor		5-factor		6-factor	
	OLS	EIV	OLS	EIV	OLS	EIV	OLS	EIV	OLS	EIV
Panel B1 : Non micro-cap stocks, With fewer characteristics in CSR										
Fstat Betas	0.33	0.32	0.78	0.63	0.92	1.11	1.1	1.05	1.41	1.39
	(0.80)	(0.81)	(0.63)	(0.77)	(0.53)	(0.35)	(0.35)	(0.40)	(0.12)	(0.13)
Fstat Chars	2.06	2.04	3.21	3.48	2.79	2.83	2.96	3.37	2.71	2.82
	(0.03)	(0.03)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
% Betas	7.4	8.1	22.2	34.2	26.2	46.4	35.1	49.3	38.0	56.0
% Chars	94.1	93.6	88.9	96.5	84.7	91.7	74.3	75.0	69.8	69.6
% Diff	86.7	85.5	66.8	62.3	58.5	45.3	39.2	25.7	31.8	13.6
	(76.5, 100.9)	(74.7, 100.9)	(56.7, 100.0)	(50.7, 100.2)	(53.4, 93.2)	(35.9, 90.4)	(24.4, 82.4)	(12.7, 76.4)	(21.0, 75.6)	(1.4, 59.1)
Panel B2 : Non micro-cap stocks, With all characteristics in CSR										
Fstat Betas	0.18	0.16	0.65	0.58	0.86	1.08	1.09	1.05	1.39	1.43
	(0.91)	(0.92)	(0.75)	(0.82)	(0.59)	(0.37)	(0.37)	(0.40)	(0.13)	(0.11)
Fstat Chars	1.92	1.96	3.11	3.34	2.79	2.8	3.11	3.36	2.93	2.85
	(0.02)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
% Betas	4.2	4.7	12.5	21.4	17.7	34.9	23.6	37.5	27.0	45.5
% Chars	99.3	99.5	94.3	98.9	89.4	92.7	82.0	79.9	76.4	72.6
% Diff	95.1	94.8	81.8	77.5	71.7	57.8	58.4	42.4	49.4	27.0
	(92.1, 102.5)	(92.1, 103.0)	(79.8, 101.5)	(74.1, 103.4)	(70.6, 94.1)	(52.7, 93.4)	(50.9, 96.5)	(34.1, 81.9)	(44.2, 78.5)	(16.6, 71.8)

Conclusion

- Reject all factor models
 - Rejection not news
- Characteristics more important than betas
- Risk premiums
 - Negative on SMB
 - Positive on RMW and CMA
 - No premium on HML or MOM
 - Less robust positive premium on Mkt