SMB -
Arousal, disproportionate reactions and the size-premium

Additional Information and Tables.

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The following pages reports findings that were not included in the article published in *Pacific-Basin Finance Journal*, Volume 15, pages 315 – 328.

Our paper refers to a number of robustness checks we conducted to confirm the robustness of the inferences we make. This document reports these analyses. All of these results support inferences we made on the basis of the analyses we presented in our paper.

Equal-weighted portfolios

In using S and B from Durack *et al.* (2004) in Table I, our analysis focuses on value-weighted portfolios. It may be, however, that value-weighting may distort the analysis (perhaps by amplifying the size-premium). We considered this possibility by examining summary statistics, as they were reported in Table I, using equal-weighted metrics. The results are reported in Table A and we find that, using equal-weighted price relatives, mean and median returns are greater than those found using value-weighted indices. In contrast to the statistics for the value-weighted index reported in Table I, the null hypothesis that both equal-weighted portfolios conform to a normal distribution may be rejected. Equal weighting highlights the greater negative skewness for big firms.

TABLE A
Summary statistics for S, MID and B equal-weighted spanning portfolios
January 1990 to December 2001

This table provides the summary statistics for the monthly equal-weighted price relatives of small, big and middle Australian firms. At the start of each month all fully-paid Australian stocks listed on the ASX, excluding investment trusts, real estate trusts, banks and insurers, are ranked in ascending order based on their market capitalization figure. Market capitalization is calculated by multiplying a firm's share price by the number of shares it has outstanding. The firms ranked in the bottom 30% of market capitalization are assigned to the S portfolio, those in the middle 40% are assigned to the MID portfolio and those in the top 30% are assigned to the B portfolio. Portfolios are rebalanced monthly. Price relatives are calculated using discrete daily price relatives converted to form a monthly index. The Jarque-Bera tests the null hypothesis that the portfolio is normally distributed. The Sharpe Ratio is calculated as follows: $(R_{Portfolio}-R_{T\text{-}bill}/\text{Standard Deviation}_{Portfolio})$. Wilcoxon is the Wilcoxon Signed Ranks Test which tests the null hypothesis that the median difference between the individual matched pairs of the S and B portfolios is zero. Ljung-Box tests the joint hypothesis that all the autocorrelations up to the specified lag are simultaneously equal to zero.

Portfolio	Mean	Median	Std. Dev	Skewness	Kurtosis	Jarque-Bera	p-value	Sharpe Ratio	Wilcoxon	p-value
S	1.0734	1.0645	0.0981	0.7215	3.7595	15.9530	0.0003	0.6926	-8.0111	0.0000
MID	1.0163	1.0159	0.0567	-0.2107	3.7458	4.4033	0.1106	0.1920		
B	1.0100	1.0126	0.0408	-0.6268	3.7106	12.4600	0.0020	0.1111		
T-bill	1.0055	1.0047	0.0021	1.7489	5.3716	107.1551	0.0000			

	Autocorrelation at lag											
	1				2				3			
Portfolio	Coefficient	Std. Err.	Ljung-Box	p-value	Coefficient	Std. Err.	Ljung-Box	p-value	Coefficient	Std. Err.	Ljung-Box	p-value
S	0.1789	0.0833	4.7069	0.0300	0.1599	0.0860	8.4907	0.0140	0.0938	0.0880	9.8014	0.0200
MID	0.1658	0.0833	4.0423	0.0440	0.0222	0.0856	4.1154	0.1280	0.1501	0.0856	7.4742	0.0580
B	0.0603	0.0833	0.5351	0.4640	0.0295	0.0836	0.6643	0.7170	0.0531	0.0838	1.0840	0.7810

CAPM alphas as a measure of risk-adjusted performance

In Table I of the paper, we used the Sharpe Ratio as an indicator of relative return rather than the α of a model such as the CAPM or the three-factor model. Noting that there is still considerable dispute as to the appropriate model of returns to use for Australian data (Durand et al., 2006) we argue that use of the Sharpe ratio entailed the lowest commitment to a model capturing a tradeoff between risk and return. In Table B, however, we consider if there are positive alphas when the CAPM is used to model excess returns of S and B. We find that our inference about the returns of S being greater than B (made on the basis of average returns and the Sharpe ratio reported in Table I) is supported by this analysis. The null hypothesis that CAPM-alpha for B is equal to zero cannot be rejected but the alpha for S is positive and statistically significant.

TABLE B
Modeling S and B stock market returns
Ordinary Least Squares regression results using the CAPM
January 1990 to December 2001

This table presents Ordinary Least Squares regression analyses of the following equations:

$$S_{it} - R_f = \alpha_1 + \beta_1(R_m - R_f) \qquad (1)$$

$$B_{it} - R_f = \alpha_2 + \beta_2(R_m - R_f) \qquad (2)$$

Here, R_f is the monthly 90-day Australian Treasury bill price relative, $S_{it} - R_f$ is the price relative of the excess return of the value-weighted small firm portfolio, B_{it} is the price relative of the excess returns of the value-weighted big firm portfolio, R_m is the value-weighted price relative of all fully-paid Australian stocks listed on the ASX, excluding investment trusts, real estate trusts, banks and insurers. AIC is the Akaike Information Criterion. SIC is the Schwarz Information Criterion. T-statistics are adjusted for heteroscedasticity (White, 1980). The Durbin Watson statistic measures the serial correlation in the residuals.

Variable	S_{it}-R_f		B_{it}-R_f	
Coefficient	α_1	β_1	α_2	β_2
Estimate	0.0411	1.0820	0.0001	1.0108
t-statistic	6.1501	6.6214	0.0540	20.9647
p-value	0.0000	0.0000	0.9570	0.0000
R-squared	0.1939		0.8061	
Log-likelihood	160.4878		375.4742	
AIC	-2.2012		-5.1871	
SIC	-2.1600		-5.1459	
Durbin-Watson	1.6478		1.8422	

Orthogonalization

We also considered if the regression analysis reported in Table IV is sensitive to the orthogonolization procedure we adopted. Firstly, we simply subtract the monthly market return from the returns of our portfolios; the results of the regression using this alternate method to remove any shared effect of the market are reported in Table C. Secondly, we repeat this analysis without orthogonalizing the data; the results of this analysis are reported in Table C. Tables C and D show that the inferences we made on the basis of the analysis reported in Table IV are robust to these variations in methodology.

TABLE C
Modeling S and B stock market returns using
an alternative methodology to remove market-wide effects

We repeat the analysis in Table IV to examine if the inferences made on the basis of that analysis are robust to the orthogonalisation of the variables. This table presents Full-Information Maximum Likelihood System regression results starting with the following two systems:

$$S^{o}_{it} = c_0 + c_1 TR_{Low} + c_2 TR_{High} + c_3 Winner + c_4 Loser + c_5 D_{jul} + c_6 T\text{-}bill + c_7 S\&P + c_8 S\&P(-1) \qquad (1)$$

$$B^{o}_{it} = c_0 + c_1 TR_{Low} + c_2 TR_{High} + c_3 Winner + c_4 Loser + c_5 D_{jul} + c_6 T\text{-}bill + c_7 S\&P + c_8 S\&P(-1) \qquad (2)$$

Here, the effect of market-wide influences are dealth with by subtracting the monthly market return from the monthly spanning portfolio return (Rm-Rf) to obtain S^{o}_{it} and B^{o}_{it}. TR_{Low} represents the price relative of the low turnover ratio spanning portfolio, TR_{High} represents the price relative of the high turnover ratio spanning portfolio, *Winner* represents the price relative of the momentum winner spanning portfolio, *Loser* represents the price relative of the momentum loser spanning portfolio, D_{jul} is a dummy variable for the month of July, *T-bill* is the monthly 90-day Australian Treasury bill price relative, *S&P* is the price relative series of the US Standard & Poor 500 Index. *S&P(-1)* is S&P at lag one month. As has been done to obtain obtain S^{o}_{it} and B^{o}_{it}., the effect of market-wide influences are dealt with by subtracting the monthly market returns of TR_{Low}, TR_{High}, *Winner* and *Loser* from the monthly spanning portfolio return (Rm-Rf) Ljung-Box tests the joint hypothesis that the autocorrelation of the residuals at lag one is equal to zero. AIC is the Akaike Information Criterion. SIC is the Schwarz Information Criterion. The null of the Wald Test is that the estimated coefficients for S^{o}_{it} equal those estimated for B^{o}_{it}.

Coefficient	c_0	$c_{TR\text{-}low}$	$c_{TR\text{-}high}$	c_{winner}	c_{loser}	c_{djul}	c_{tbill}	$c_{S\&P}$	$c_{S\&P(-1)}$
S^{O}									
Estimate	1.9613	-0.5711	0.5262	0.2829	0.2034	-1.7432	0.0597	-0.1205	-0.0506
z-statistic	0.8721	-2.0805	8.1555	3.2449	2.1392	-0.7808	4.8155	-1.0720	-0.3832
p-value	0.3831	0.0375	0.0000	0.0012	0.0324	0.4349	0.0000	0.2837	0.7016
R-squared	0.6405								
Ljung-Box	1.1002								
p-value	0.2940								
B^{O}									
Estimate	0.5986	0.8554	0.0279	0.0250	0.0157	-0.5820	-0.0025	0.0091	-0.0223
z-statistic	2.4080	22.2237	2.6809	1.8932	1.0068	-2.2932	-0.7116	0.5404	-1.4368
p-value	0.0160	0.0000	0.0073	0.0583	0.3140	0.0218	0.4767	0.5889	0.1508
R-squared	0.8647								
Ljung-Box	1.9526								
p-value	0.1620								
WALD TEST									
Chi-square	366.6681								
p-value	0.0000								
z-statistic	1.3626	-1.4265	0.4984	0.2579	0.1877	-1.1612	0.0622	-0.1296	-0.0283
Std Error	2.2692	0.2715	0.0655	0.0921	0.0983	2.2574	0.0139	0.1127	0.1355
SYSTEM									
Log-likelihood	754.8491								
AIC	-10.3729								
SIC	-10.3641								

TABLE D
Modeling unorthogonalised S and B stock market returns
January 1990 to December 2001

We repeat the analysis in Table IV to examine if the inferences made on the basis of that analysis are robust to the orthogonalisation of the variables. This table presents Full-Information Maximum Likelihood System regression results starting with the following two systems:

$$S_{it} = c_0 + c_1 TR_{Low} + c_2 TR_{High} + c_3 Winner + c_4 Loser + c_5 D_{jul} + c_6 T\text{-}bill + c_7 S\&P + c_8 S\&P(-1) \qquad (1)$$

$$B_{it} = c_0 + c_1 TR_{Low} + c_2 TR_{High} + c_3 Winner + c_4 Loser + c_5 D_{jul} + c_6 T\text{-}bill + c_7 S\&P + c_8 S\&P(-1) \qquad (2)$$

Here, S_{it} and B_{it} are unorthogonalized metrics. TR_{Low} represents the price relative of the low turnover ratio spanning portfolio, TR_{High} represents the price relative of the high turnover ratio spanning portfolio, *Winner* represents the price relative of the momentum winner spanning portfolio, *Loser* represents the price relative of the momentum loser spanning portfolio, D_{jul} is a dummy variable for the month of July, *T-bill* is the monthly 90-day Australian Treasury bill price relative, *S&P* is the price relative series of the US Standard & Poor 500 Index. *S&P(-1)* is S&P at lag one month. To be consistent with our treatment of S_{it} and B_{it} in the analysis reported in this table, TR_{Low}, TR_{High}, *Winner* and *Loser* are also unorthogonalized. Ljung-Box tests the joint hypothesis that the autocorrelation of the residuals at lag one is equal to zero. AIC is the Akaike Information Criterion. SIC is the Schwarz Information Criterion. The null of the Wald Test is that the estimated coefficients for S^o_{it} equal those estimated for B^o_{it}.

Coefficient	c_0	$c_{TR\text{-}low}$	$c_{TR\text{-}high}$	c_{winner}	c_{loser}	c_{djul}	c_{tbill}	$c_{S\&P}$	$c_{S\&P(-1)}$
S									
Estimate	2.9632	-0.4101	0.5612	0.2671	0.2332	-2.5617	0.0615	-0.0023	-0.0015
z-statistic	1.2948	-2.7248	8.9216	3.3515	2.5653	-1.1292	5.0524	-0.0202	-0.0114
p-value	0.1954	0.0064	0.0000	0.0008	0.0103	0.2588	0.0000	0.9839	0.9909
R-squared	0.7190								
Ljung-Box	2.9124								
p-value	0.0880								
B									
Estimate	0.6722	0.9213	0.0279	0.0267	0.0262	-0.6707	-0.0024	0.0145	-0.0148
z-statistic	2.7025	40.2624	2.5395	2.0366	1.7604	-2.6605	-0.7537	0.8319	-1.0799
p-value	0.0069	0.0000	0.0111	0.0417	0.0783	0.0078	0.4510	0.4054	0.2802
R-squared	0.9711								
Ljung-Box	0.8238								
p-value	0.3640								
WALD TEST									
Chi-square	389.9977								
p-value	0.0000								
z-statistic	2.2911	-1.3314	0.5334	0.2404	0.2070	-1.8911	0.0639	-0.0168	0.0133
Std Error	2.3147	0.1554	0.0640	0.0838	0.0922	2.3004	0.0133	0.1178	0.1314
SYSTEM									
Log-likelihood	754.6174								
AIC	-10.3697								
SIC	-10.3609								

Delisting bias

Shumway (1997) and Shumway and Warther (1999) argue that smaller sized firms delist more often than larger firms, and that when they delist it is most likely that the reason is related to performance, which could introduce an upward bias into the calculation of the small firm portfolio returns. Our reported results in Table 1 show portfolios formed with stocks removed in their final month of listing. The analysis is repeated here using different assumptions on the treatment of delisted stocks. We report the descriptive monthly price relatives of both portfolios that are forward-filled in their delisting month, with and without incorporating a control for firms that delist. The methodology used when not incorporating a delisting bias control, and presented in Table E, simply involves forward-filling the price series of a delisting stock with a price relative of 1, thus assuming a 0% return, when there are no more share prices for that stock.

In Table F, a different methodology of forward-filling is introduced. That is, a price relative of 0, which equates to a terminal value of -100%, is assigned to all delisting firms on the day after their last share price. In this case, we are assuming investors lose their entire investment. The inferences we draw from the analyses reported in the main paper are robust to the differing assumptions.

TABLE E

Summary statistics for small and big firm spanning portfolios stock with forward filling in delisting month

January 1990 to December 2001

This table provides the summary statistics for the monthly price relatives of small and big Australian firms without controlling for any potential delisting bias. At the start of each month all fully-paid Australian stocks listed on the ASX, excluding investment trusts, real estate trusts, banks and insurers, are ranked in ascending order based on their market capitalization figure. Market capitalization is calculated by multiplying a firm's share price by the number of shares it has outstanding. The firms ranked in the bottom 30% of market capitalization are assigned to the Small portfolio and those in the top 30% are assigned to the Big portfolio. Portfolios are rebalanced monthly. Price relatives are calculated using discrete daily price relatives converted to form a monthly index. If a price is missing due to delisting, prices are forward-filled with a price relative of 1. The Jarque-Bera tests the null hypothesis that the portfolio is normally distributed. The Sharpe Ratio is calculated as follows: (RPortfolio-RT-bill/Standard DeviationPortfolio). Wilcoxon is the Wilcoxon Signed Ranks Test which tests the null hypothesis that the median difference between the individual matched pairs in the sample is zero. Ljung-Box tests the joint hypothesis that all the autocorrelations up to the specified lag are simultaneously equal to zero. Panel A provides the summary statistics for value-weighted price relatives and Panel B provides the summary statistics for equal-weighted price relatives.

Portfolio	Mean	Median	Std. Dev	Skewness	Kurtosis	Jarque-Bera	p-value	Sharpe Ratio	Wilcoxon	p-value
S	1.0516	1.0452	0.0886	0.5499	3.2245	7.5594	0.0228	0.5213	-6.2841	0.0000
B	1.0055	1.0024	0.0696	-0.0217	4.5627	14.6638	0.0007	0.0003		
T-bill	1.0055	1.0047	0.0021	1.7489	5.3716	107.1551	0.0000			

	Autocorrelation at lag											
	1				2				3			
Portfolio	Coefficient	Std. Err.	Ljung-Box	p-value	Coefficient	Std. Err.	Ljung-Box	p-value	Coefficient	Std. Err.	Ljung-Box	p-value
S	0.1959	0.0833	5.6432	0.0175	0.0927	0.0865	6.9160	0.0315	0.0734	0.0872	7.7200	0.0522
B	0.0428	0.0833	0.2693	0.6038	-0.0249	0.0835	0.3611	0.8348	0.0992	0.0835	1.8274	0.6090

TABLE F

Summary statistics for small and big firm spanning portfolios stock with full-losses in delisting month
January 1990 to December 2001

This table provides the summary statistics for the monthly price relatives of small and big Australian firms without controlling for any potential delisting bias. At the start of each month all fully-paid Australian stocks listed on the ASX, excluding investment trusts, real estate trusts, banks and insurers, are ranked in ascending order based on their market capitalization figure. Market capitalization is calculated by multiplying a firm's share price by the number of shares it has outstanding. The firms ranked in the bottom 30% of market capitalization are assigned to the Small portfolio and those in the top 30% are assigned to the Big portfolio. Portfolios are rebalanced monthly. Price relatives are calculated using discrete daily price relatives converted to form a monthly index. If a price is missing due to delisting, prices are forward-filled with a price relative of 0. The Jarque-Bera tests the null hypothesis that the portfolio is normally distributed. The Sharpe Ratio is calculated as follows: (RPortfolio-RT-bill/Standard DeviationPortfolio). Wilcoxon is the Wilcoxon Signed Ranks Test which tests the null hypothesis that the median difference between the individual matched pairs in the sample is zero. Ljung-Box tests the joint hypothesis that all the autocorrelations up to the specified lag are simultaneously equal to zero. Panel A provides the summary statistics for value-weighted price relatives and Panel B provides the summary statistics for equal-weighted price relatives.

Portfolio	Mean	Median	Std. Dev	Skewness	Kurtosis	Jarque-Bera	p-value	Sharpe Ratio	Wilcoxon	p-value
S	1.0504	1.0393	0.0888	0.5443	3.2313	7.4316	0.0243	0.5062	-6.2601	0.0000
B	1.0037	0.9959	0.0693	0.0202	4.6063	15.4902	0.0004	-0.0258		
T-bill	1.0055	1.0047	0.0021	1.7489	5.3716	107.1551	0.0000			

	Autocorrelation at lag											
	1				2				3			
Portfolio	Coefficient	Std. Err.	Ljung-Box	p-value	Coefficient	Std. Err.	Ljung-Box	p-value	Coefficient	Std. Err.	Ljung-Box	p-value
S	0.1930	0.0833	5.4776	0.0193	0.0845	0.0863	6.5359	0.0381	0.0838	0.0870	7.5841	0.0554
B	0.0075	0.0833	0.0083	0.9275	0.0018	0.0833	0.0088	0.9956	0.1029	0.0833	1.5881	0.6621

Sub-period summary statistics and regressions

In order to confirm that our results are not driven by events peculiar to a specific period of time, Table G provides the results for the period January 1990 to December 1995. Table H provides the results for the period January 1996 to December 2001.

We also reconsider the regression analysis presented in Table IV for the sub-periods January 1990 to December 1995 (the results are reported in Table I), and January 1996 to December 2001 (the results are reported in Table J). These analyses are consistent with the results reported in Table IV and therefore confirm that the results are not driven by a particular sub-period.

TABLE G
Summary statistics for S and B spanning portfolios using value-weighted returns
January 1990 to December 1995

This table provides the summary statistics for the monthly value-weighted price relatives of small and big Australian firms. At the start of each month all fully-paid Australian stocks listed on the ASX, excluding investment trusts, real estate trusts, banks and insurers, are ranked in ascending order based on their market capitalization figure. Market capitalization is calculated by multiplying a firm's share price by the number of shares it has outstanding. The firms ranked in the bottom 30% of market capitalization are assigned to the S portfolio and those in the top 30% are assigned to the B portfolio. Portfolios are rebalanced monthly. Price relatives are calculated using discrete daily price relatives converted to form a monthly index. The Jarque-Bera tests the null hypothesis that the portfolio is normally distributed. The Sharpe Ratio is calculated as follows: $(R_{Portfolio}-R_{T\text{-}bill}/\text{Standard Deviation}_{Portfolio})$. Wilcoxon is the Wilcoxon Signed Ranks Test which tests the null hypothesis that the median difference between the individual matched pairs of the S and B portfolios is zero. Ljung-Box tests the joint hypothesis that all the autocorrelations up to the specified lag are simultaneously equal to zero.

Portfolio	Mean	Median	Std. Dev	Skewness	Kurtosis	Jarque-Bera	p-value	Sharpe Ratio	Wilcoxon	p-value
S	1.0523	1.0341	0.0855	0.8566	3.3883	9.2581	0.0098	0.5355	-3.6532	0.0003
B	1.0104	1.0112	0.0418	0.1884	2.2848	1.9607	0.3752	0.0947		
T-bill	1.0065	1.0060	0.0025	0.9251	2.7236	10.4999	0.0052			

	Autocorrelation at lag											
	1				2				3			
Portfolio	Coefficient	Std. Err.	Ljung-Box	p-value	Coefficient	Std. Err.	Ljung-Box	p-value	Coefficient	Std. Err.	Ljung-Box	p-value
S	0.3618	0.1179	9.8203	0.0020	0.2325	0.1324	13.9358	0.0010	0.1988	0.1379	16.9860	0.0010
B	-0.1795	0.1179	2.4186	0.1200	0.1461	0.1216	4.0439	0.1320	-0.0535	0.1240	4.2650	0.2340

TABLE H
Summary statistics for S and B spanning portfolios using value-weighted returns
January 1996 to December 2001

This table provides the summary statistics for the monthly value-weighted price relatives of small and big Australian firms. At the start of each month all fully-paid Australian stocks listed on the ASX, excluding investment trusts, real estate trusts, banks and insurers, are ranked in ascending order based on their market capitalization figure. Market capitalization is calculated by multiplying a firm's share price by the number of shares it has outstanding. The firms ranked in the bottom 30% of market capitalization are assigned to the S portfolio, those in the middle 40% are assigned to the M portfolio and those in the top 30% are assigned to the B portfolio. Portfolios are rebalanced monthly. Price relatives are calculated using discrete daily price relatives converted to form a monthly index. The Jarque-Bera tests the null hypothesis that the portfolio is normally distributed. The Sharpe Ratio is calculated as follows: $(R_{Portfolio}-R_{T\text{-}bill}/\text{Standard Deviation}_{Portfolio})$. Wilcoxon is the Wilcoxon Signed Ranks Test which tests the null hypothesis that the median difference between the individual matched pairs of the S and B portfolios is zero. Ljung-Box tests the joint hypothesis that all the autocorrelations up to the specified lag are simultaneously equal to zero.

Portfolio	Mean	Median	Std. Dev	Skewness	Kurtosis	Jarque-Bera	p-value	Sharpe Ratio	Wilcoxon	p-value
S	1.0479	1.0477	0.0918	0.3559	3.0565	1.5296	0.4654	0.4742	-3.6700	0.0002
B	1.0073	1.0095	0.0394	-0.4260	3.4322	2.7379	0.2544	0.0720		
T-bill	1.0044	1.0041	0.0007	0.8654	2.7288	9.2080	0.0100			

	Autocorrelation at lag											
	1				2				3			
Portfolio	Coefficient	Std. Err.	Ljung-Box	p-value	Coefficient	Std. Err.	Ljung-Box	p-value	Coefficient	Std. Err.	Ljung-Box	p-value
S	0.0531	0.1179	0.2119	0.6450	0.0114	0.1182	0.2217	0.8950	0.0130	0.1182	0.2349	0.9720
B	-0.0777	0.1179	0.4528	0.5010	-0.0804	0.1186	0.9443	0.6240	0.0576	0.1193	1.2003	0.7530

TABLE I
Modeling S and B stock market returns
Full-Information Maximum Likelihood System results using turnover ratio, momentum, interest rates and S&P 500 metrics
January 1990 to December 1995

This table presents Full-Information Maximum Likelihood System regression results starting with the following two systems:

$$S^o_{it} = c_0 + c_1 TR_{Low} + c_2 TR_{High} + c_3 Winner + c_4 Loser + c_5 D_{jul} + c_6 T\text{-}bill + c_7 S\&P + c_8 S\&P(-1) \qquad (1)$$

$$B^o_{it} = c_0 + c_1 TR_{Low} + c_2 TR_{High} + c_3 Winner + c_4 Loser + c_5 D_{jul} + c_6 T\text{-}bill + c_7 S\&P + c_8 S\&P(-1) \qquad (2)$$

Here, S^o_{it} is the orthogonalized price relative of the small firm spanning portfolio, B^o_{it} is the orthogonalized price relative of the big firm spanning portfolio, TR_{Low} represents the price relative of the low turnover ratio spanning portfolio, TR_{High} represents the price relative of the high turnover ratio spanning portfolio, *Winner* represents the price relative of the momentum winner spanning portfolio, *Loser* represents the price relative of the momentum loser spanning portfolio, D_{jul} is a dummy variable for the month of July, *T-bill* is the monthly 90-day Australian Treasury bill price relative, *S&P* is the price relative series of the US Standard & Poor 500 Index. *S&P(-1)* is S&P at lag one month. TR_{Low}, TR_{High}, *Winner* and *Loser* are orthogonalized to the market (in the same way that S^o and B^o have been othogonalized in this analysis). Ljung-Box tests the joint hypothesis that the autocorrelation of the residuals at lag one is equal to zero. AIC is the Akaike Information Criterion. SIC is the Schwarz Information Criterion. The null of the Wald Test is that the estimated coefficients for S^o_{it} equal those estimated for B^o_{it}.

Coefficient	c_0	$c_{TR\text{-}low}$	$c_{TR\text{-}high}$	c_{winner}	c_{loser}	c_{djul}	c_{tbill}	$c_{S\&P}$	$c_{S\&P(-1)}$
S^O									
Estimate	2.1656	-0.1848	0.5649	0.3266	0.1996	0.0508	-2.0669	-0.0130	-0.0789
z-statistic	0.6517	-0.4827	4.6822	2.7261	1.1663	1.6742	-0.6006	-0.0579	-0.3998
p-value	0.5146	0.6293	0.0000	0.0064	0.2435	0.0941	0.5481	0.9538	0.6893
R-squared	0.6270								
Ljung-Box	1.5734								
p-value	0.2100								
B^O									
Estimate	0.5301	0.7471	-0.0051	0.0317	0.0300	-0.0036	-0.4676	-0.0276	-0.0314
z-statistic	1.3468	12.0674	-0.3482	1.5872	1.1119	-0.4210	-1.1817	-1.0244	-1.8123
p-value	0.1780	0.0000	0.7277	0.1125	0.2662	0.6738	0.2373	0.3056	0.0699
R-squared	0.8745								
Ljung-Box	3.7093								
p-value	0.0540								
WALD TEST									
Chi-square	138.7350								
p-value	0.0000								
z-statistic	1.6354	-0.9318	0.5700	0.2948	0.1695	0.0544	-1.5993	0.0145	-0.0475
Std Error	3.2826	0.3729	0.1202	0.1216	0.1824	0.0372	3.3891	0.2191	0.1999
SYSTEM									
Log-likelihood	393.3070								
AIC	-5.3515								
SIC	-5.3427								

TABLE J
Modeling S and B stock market returns
Full-Information Maximum Likelihood System results using turnover ratio, momentum, interest rates and S&P 500 metrics
January 1996 to December 2001

This table presents Full-Information Maximum Likelihood System regression results starting with the following two systems:

$$S^o_{it} = c_0 + c_1 TR_{Low} + c_2 TR_{High} + c_3 Winner + c_4 Loser + c_5 D_{jul} + c_6 T\text{-}bill + c_7 S\&P + c_8 S\&P(-1) \qquad (1)$$

$$B^o_{it} = c_0 + c_1 TR_{Low} + c_2 TR_{High} + c_3 Winner + c_4 Loser + c_5 D_{jul} + c_6 T\text{-}bill + c_7 S\&P + c_8 S\&P(-1) \qquad (2)$$

Here, S^o_{it} is the orthogonalized price relative of the small firm spanning portfolio, B^o_{it} is the orthogonalized price relative of the big firm spanning portfolio, TR_{Low} represents the price relative of the low turnover ratio spanning portfolio, TR_{High} represents the price relative of the high turnover ratio spanning portfolio, *Winner* represents the price relative of the momentum winner spanning portfolio, *Loser* represents the price relative of the momentum loser spanning portfolio, D_{jul} is a dummy variable for the month of July, *T-bill* is the monthly 90-day Australian Treasury bill price relative, *S&P* is the price relative series of the US Standard & Poor 500 Index. *S&P(-1)* is S&P at lag one month. TR_{Low}, TR_{High}, *Winner* and *Loser* are orthogonalized to the market (in the same way that S^o and B^o have been othogonalized in this analysis). Ljung-Box tests the joint hypothesis that the autocorrelation of the residuals at lag one is equal to zero. AIC is the Akaike Information Criterion. SIC is the Schwarz Information Criterion. The null of the Wald Test is that the estimated coefficients for S^o_{it} equal those estimated for B^o_{it}.

Coefficient	c_0	$c_{TR\text{-}low}$	$c_{TR\text{-}high}$	c_{winner}	c_{loser}	c_{djul}	c_{tbill}	$c_{S\&P}$	$c_{S\&P(-1)}$
S^O									
Estimate	7.8314	-0.8673	0.5381	0.1457	0.3672	0.0636	-7.7707	-0.0351	0.0075
z-statistic	0.7270	-1.8888	5.4281	0.5916	2.4239	3.9759	-0.7316	-0.2240	0.0364
p-value	0.4672	0.0589	0.0000	0.5541	0.0154	0.0001	0.4644	0.8228	0.9709
R-squared	0.7126								
Ljung-Box	0.1719								
p-value	0.6780								
B^O									
Estimate	0.7866	0.9594	0.0397	-0.0188	0.0119	-0.0014	-0.7485	0.0019	-0.0352
z-statistic	0.4510	14.4344	2.0429	-0.5145	0.4870	-0.2601	-0.4316	0.0857	-1.6578
p-value	0.6520	0.0000	0.0411	0.6069	0.6262	0.7948	0.6660	0.9317	0.0974
R-squared	0.8856								
Ljung-Box	0.1933								
p-value	0.6600								
WALD TEST									
Chi-square	104.1404								
p-value	0.0000								
z-statistic	7.0448	-1.8266	0.4985	0.1646	0.3552	0.0650	-7.0222	-0.0369	0.0427
Std Error	11.0050	0.4781	0.1014	0.2525	0.1591	0.0170	10.8464	0.1556	0.2045
SYSTEM									
Log-likelihood	380.4728								
AIC	-5.1732								
SIC	-5.1644								

Specification of S and B portfolios

We further consider the sensitivities of our regression analyses to the specification of our S and B portfolios. We repeat the regression analysis reported in Table IV in section 3 using both decile and quintile groupings to define S and B portfolios (which we then orthogonalize to obtain S^O and B^O as we do in the main body of the paper). These results are presented in Tables K and L, respectively. The conclusions we draw on the basis of the analysis reported in the paper appear to be robust with respect to these different specifications of these portfolios.

Alternative definitions of liquidity

Finally, we repeat the regression analysis reported in Table IV in section 3 using alternative definitions of liquidity, with a view to examining the sensitivity of our results to the definition of liquidity we adopt. These tests appear in Tables M, where we use the number of shares traded to determine liquidity, and N, where we use the dollar volume of trades as our liquidity metric. Using these alternative definitions of liquidity does not have any material effect on the inferences we draw from our analyses.

TABLE K
Modeling S and B size-based decile stock market returns
January 1990 to December 2001

This table presents Full-Information Maximum Likelihood System regression results starting with the following two systems:

$$S^o_{it} = c_0 + c_1 TR_{Low} + c_2 TR_{High} + c_3 Winner + c_4 Loser + c_5 D_{jul} + c_6 T\text{-}bill + c_7 S\&P + c_8 S\&P(-1) \qquad (1)$$

$$B^o_{it} = c_0 + c_1 TR_{Low} + c_2 TR_{High} + c_3 Winner + c_4 Loser + c_5 D_{jul} + c_6 T\text{-}bill + c_7 S\&P + c_8 S\&P(-1) \qquad (2)$$

Here, S^o_{it} is the orthogonalized price relative of the small firm spanning portfolio, B^o_{it} is the orthogonalized price relative of the big firm spanning portfolio, TR_{Low} represents the price relative of the low turnover ratio spanning portfolio, TR_{High} represents the price relative of the high turnover ratio spanning portfolio, *Winner* represents the price relative of the momentum winner spanning portfolio, *Loser* represents the price relative of the momentum loser spanning portfolio, D_{jul} is a dummy variable for the month of July, *T-bill* is the monthly 90-day Australian Treasury bill price relative, *S&P* is the price relative series of the US Standard & Poor 500 Index. *S&P(-1)* is S&P at lag one month. TR_{Low}, TR_{High}, *Winner* and *Loser* are orthogonalized to the market (in the same way that S^o and B^o have been othogonalized in this analysis). Ljung-Box tests the joint hypothesis that the autocorrelation of the residuals at lag one is equal to zero. AIC is the Akaike Information Criterion. SIC is the Schwarz Information Criterion. The null of the Wald Test is that the estimated coefficients for S^o_{it} equal those estimated for B^o_{it}.

Coefficient	c_0	$c_{TR\text{-}low}$	$c_{TR\text{-}high}$	c_{winner}	c_{loser}	c_{djul}	c_{tbill}	$c_{S\&P}$	$c_{S\&P(-1)}$
S^O									
Estimate	3.4738	-0.2625	0.1682	0.0674	0.2575	-3.5032	0.0884	0.0807	-0.0400
z-statistic	0.6063	-0.7295	2.5617	1.2038	3.5460	-0.6271	3.1721	0.3938	-0.1339
p-value	0.5443	0.4657	0.0104	0.2287	0.0004	0.5306	0.0015	0.6938	0.8935
R-squared	0.2516								
Ljung-Box	0.8374								
p-value	0.3600								
B^O									
Estimate	-1.4866	0.1705	-0.0058	0.0070	0.0125	1.6386	-0.0010	-0.0470	-0.1119
z-statistic	-1.4989	2.3302	-0.3421	0.4615	0.8706	1.6625	-0.1107	-1.1318	-3.2402
p-value	0.1339	0.0198	0.7323	0.6444	0.3840	0.0964	0.9119	0.2577	0.0012
R-squared	0.1762								
Ljung-Box	0.1780								
p-value	0.6730								
WALD TEST									
Chi-square	59.6037								
p-value	0.0000								
value	4.9604	-0.4330	0.1741	0.0604	0.2449	-5.1418	0.0894	0.1277	0.0719
Std Error	5.9516	0.3700	0.0598	0.0621	0.0701	5.8209	0.0307	0.2174	0.2984
SYSTEM									
Log-likelihood	489.1320								
AIC	-6.6824								
SIC	-6.6736								

TABLE L
Modeling S and B size-based quintile stock market returns
January 1990 to December 2001

This table presents Full-Information Maximum Likelihood System regression results starting with the following two systems:

$$S^{o}_{it} = c_0 + c_1 TR_{Low} + c_2 TR_{High} + c_3 Winner + c_4 Loser + c_5 D_{jul} + c_6 T\text{-}bill + c_7 S\&P + c_8 S\&P(-1) \qquad (1)$$

$$B^{o}_{it} = c_0 + c_1 TR_{Low} + c_2 TR_{High} + c_3 Winner + c_4 Loser + c_5 D_{jul} + c_6 T\text{-}bill + c_7 S\&P + c_8 S\&P(-1) \qquad (2)$$

Here, S^{o}_{it} is the orthogonalized price relative of the small firm spanning portfolio, B^{o}_{it} is the orthogonalized price relative of the big firm spanning portfolio, TR_{Low} represents the price relative of the low turnover ratio spanning portfolio, TR_{High} represents the price relative of the high turnover ratio spanning portfolio, *Winner* represents the price relative of the momentum winner spanning portfolio, *Loser* represents the price relative of the momentum loser spanning portfolio, D_{jul} is a dummy variable for the month of July, *T-bill* is the monthly 90-day Australian Treasury bill price relative, *S&P* is the price relative series of the US Standard & Poor 500 Index. *S&P(-1)* is S&P at lag one month. TR_{Low}, TR_{High}, *Winner* and *Loser* are orthogonalized to the market (in the same way that S^{o} and B^{o} have been othogonalized in this analysis). Ljung-Box tests the joint hypothesis that the autocorrelation of the residuals at lag one is equal to zero. AIC is the Akaike Information Criterion. SIC is the Schwarz Information Criterion. The null of the Wald Test is that the estimated coefficients for S^{o}_{it} equal those estimated for B^{o}_{it}.

Coefficient	c_0	$c_{TR\text{-}low}$	$c_{TR\text{-}high}$	c_{winner}	c_{loser}	c_{djul}	c_{tbill}	$c_{S\&P}$	$c_{S\&P(-1)}$
S^{O}									
Estimate	4.2740	-0.2333	0.6005	0.0133	0.2104	-4.0956	0.0780	0.0637	-0.2243
z-statistic	1.4048	-0.5835	8.4040	0.1907	1.8679	-1.3774	4.5909	0.4304	-1.3696
p-value	0.1601	0.5595	0.0000	0.8488	0.0618	0.1684	0.0000	0.6669	0.1708
R-squared	0.5529								
Ljung-Box	0.0765								
p-value	0.7820								
B^{O}									
Estimate	-1.0895	0.6174	0.0210	0.0108	0.0134	1.1704	0.0004	-0.0235	-0.0628
z-statistic	-2.1234	10.8394	1.6730	2.0617	0.6464	2.3078	0.0658	-0.8255	-2.7560
p-value	0.0337	0.0000	0.0943	0.0392	0.5180	0.0210	0.9475	0.4091	0.0059
R-squared	0.6052								
Ljung-Box	0.0899								
p-value	0.9240								
WALD TEST									
Chi-square	189.9374								
p-value	0.0000								
z-statistic	5.3635	-0.8507	0.5795	0.0025	0.1970	-5.2660	0.0776	0.0872	-0.1615
Std Error	2.9950	0.3924	0.0684	0.0738	0.1116	2.9411	0.0192	0.1556	0.1646
SYSTEM									
Log-likelihood	618.3008								
AIC	-8.4764								
SIC	-8.4676								

TABLE M
Modelling S and B stock market returns
Full-Information Maximum Likelihood System results
using trading volume instead of turnover ratio.
January 1990 to December 2001

This table presents Full-Information Maximum Likelihood System regression results starting with the following two systems:

$$S^o_{it} = c_0 + c_1 TV_{Low} + c_2 TV_{High} + c_3 Winner + c_4 Loser + c_5 D_{jul} + c_6 T\text{-}bill + c_7 S\&P + c_8 S\&P(-1) \qquad (1)$$

$$B^o_{it} = c_0 + c_1 TV_{Low} + c_2 TV_{High} + c_3 Winner + c_4 Loser + c_5 D_{jul} + c_6 T\text{-}bill + c_7 S\&P + c_8 S\&P(-1) \qquad (2)$$

Here, S^o_{it} is the orthogonalized price relative of the small firm spanning portfolio, B^o_{it} is the orthogonalized price relative of the big firm spanning portfolio, TV_{Low} represents the price relative of the low trading volume spanning portfolio TV_{High} represents the price relative of the high trading volume spanning portfolio, *Winner* represents the price relative of the momentum winner spanning portfolio, *Loser* represents the price relative of the momentum loser spanning portfolio, D_{jul} is a dummy variable for the month of July, *T-bill* is the monthly 90-day Australian Treasury bill price relative, *S&P* is the price relative series of the US Standard & Poor 500 Index. *S&P(-1)* is S&P at lag one month. TV_{Low}, TV_{High}, *Winner* and *Loser* are orthogonalized to the market (in the same way that S^o and B^o have been othogonalized in this analysis). Ljung-Box tests the joint hypothesis that the autocorrelation of the residuals at lag one is equal to zero. AIC is the Akaike Information Criterion. SIC is the Schwarz Information Criterion. The null of the Wald Test is that the estimated coefficients for S^o_{it} equal those estimated for B^o_{it}.

Coefficient	c_0	$c_{TV\text{-}low}$	$c_{TV\text{-}high}$	c_{winner}	c_{loser}	c_{djul}	c_{tbill}	$c_{S\&P}$	$c_{S\&P(-1)}$
S^O									
Estimate	1.2100	0.5714	-0.5575	0.6655	0.5471	0.0735	-1.1008	-0.0015	-0.1064
z-statistic	0.3071	2.9655	-1.6228	5.5678	4.2330	4.5964	-0.2824	-0.0125	-0.7067
p-value	0.7588	0.0030	0.1046	0.0000	0.0000	0.0000	0.7776	0.9900	0.4797
R-squared	0.4612								
Ljung-Box	0.0032								
p-value	0.9550								
B^O									
Estimate	-0.0838	0.0546	0.8643	-0.0005	0.0158	-0.0016	0.0817	0.0026	-0.0008
z-statistic	-0.6030	4.1975	52.5205	-0.0622	3.7176	-0.8216	0.6067	0.3094	-0.1074
p-value	0.5465	0.0000	0.0000	0.9504	0.0002	0.4113	0.5441	0.7570	0.9145
R-squared	0.9770								
Ljung-Box	10.1533								
p-value	0.0010								
WALD TEST									
Chi-square	131.7224								
p-value	0.0000								
z-statistic	1.2938	0.5167	-1.4219	0.6660	0.5313	0.0752	-1.1825	-0.0041	-0.1057
Std Error	3.9553	0.1935	0.3422	0.1239	0.1275	0.0166	3.9133	0.1235	0.1522
SYSTEM									
Log-likelihood	852.6713								
AIC	-11.7315								
SIC	-11.7227								

TABLE N
Modelling S and B stock market returns
Full-Information Maximum Likelihood System results using
dollar-trading volume instead of turnover ratio.
January 1990 to December 2001

This table presents Full-Information Maximum Likelihood System regression results starting with the following two systems:

$$S^{o}_{it} = c_0 + c_1 DTV_{Low} + c_2 DTV_{High} + c_3 Winner + c_4 Loser + c_5 D_{jul} + c_6 T\text{-}bill + c_7 S\&P + c_8 S\&P(-1) \qquad (1)$$

$$B^{o}_{it} = c_0 + c_1 DTV_{Low} + c_2 DTV_{High} + c_3 Winner + c_4 Loser + c_5 D_{jul} + c_6 T\text{-}bill + c_7 S\&P + c_8 S\&P(-1) \qquad (2)$$

Here, S^{o}_{it} is the orthogonalized price relative of the small firm spanning portfolio, B^{o}_{it} is the orthogonalized price relative of the big firm spanning portfolio, DTV_{Low} represents the price relative of the low dollar-trading volume spanning portfolio DTV_{High} represents the price relative of the high dollar-trading volume spanning portfolio, *Winner* represents the price relative of the momentum winner spanning portfolio, *Loser* represents the price relative of the momentum loser spanning portfolio, D_{jul} is a dummy variable for the month of July, *T-bill* is the monthly 90-day Australian Treasury bill price relative, *S&P* is the price relative series of the US Standard & Poor 500 Index. *S&P(-1)* is S&P at lag one month. DTV_{Low}, DTV_{High}, *Winner* and *Loser* are orthogonalized to the market (in the same way that S^{o} and B^{o} have been othogonalized in this analysis). Ljung-Box tests the joint hypothesis that the autocorrelation of the residuals at lag one is equal to zero. AIC is the Akaike Information Criterion. SIC is the Schwarz Information Criterion. The null of the Wald Test is that the estimated coefficients for S^{o}_{it} equal those estimated for B^{o}_{it}.

Coefficient	c_0	$c_{TV\text{-}low}$	$c_{TV\text{-}high}$	c_{winner}	c_{loser}	c_{djul}	c_{tbill}	$c_{S\&P}$	$c_{S\&P(-1)}$
S^{O}									
Estimate	2.4454	0.8143	-0.3285	0.6079	0.4864	0.0489	-2.4129	-0.0050	-0.0180
z-statistic	0.7194	5.3694	-1.0066	5.1738	5.2570	2.8170	-0.7220	-0.0402	-0.1297
p-value	0.4719	0.0000	0.3141	0.0000	0.0000	0.0048	0.4703	0.9680	0.8968
R-squared	0.5317								
Ljung-Box									
p-value									
B^{O}									
Estimate	-0.4716	0.0580	0.8529	-0.0118	-0.0215	-0.0021	0.4531	0.0157	0.0003
z-statistic	-2.2641	2.5745	26.7273	-0.5975	-1.9188	-0.6968	2.2300	1.0680	0.0259
p-value	0.0236	0.0100	0.0000	0.5501	0.0550	0.4859	0.0257	0.2855	0.9793
R-squared	0.8844								
Ljung-Box									
p-value									
WALD TEST									
Chi-square	131.6204								
p-value	0.0000								
z-statistic	2.9170	0.7563	-1.1814	0.6197	0.5079	0.0510	-2.8660	-0.0207	-0.0184
Std Error	3.3910	0.1596	0.3300	0.1303	0.0952	0.0188	3.3295	0.1318	0.1412
SYSTEM									
Log-likelihood	750.7415								
AIC	-10.3159								
SIC	-10.3071								