Accepted Manuscript

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PII: S0378-4266(17)30195-4
DOI: 10.1016/j.jbankfin.2017.08.007
Reference: JBF 5190

To appear in: *Journal of Banking and Finance*

Received date: 13 September 2016
Revised date: 2 June 2017
Accepted date: 8 August 2017

Please cite this article as: Min Bai , Xiao-Ming Li , Yafeng Qin , Shortability and Asset Pricing Model: Evidence from The Hong Kong Stock Market, *Journal of Banking and Finance* (2017), doi: 10.1016/j.jbankfin.2017.08.007

Shortability and Asset Pricing Model: Evidence from The Hong Kong Stock Market

Min Bai* Xiao-Ming Li† Yafeng Qin‡

Abstract

This study explores how the violation of free short selling assumption affects the performance of CAPM and the Fama-French three-factor model, as existing studies show that short-sales constraints affect asset pricing of the stocks. Using data from the Hong Kong Stock Market which has unique regulations on short selling, we conduct both time-series and cross-sectional regression analyses to evaluate the performance of the two models under the short-sales-constraints and the no-constraints market environment. The two models perform much worse in the former environment than in the latter, indicating a significant impact of the short sales constraints on the explanatory power of the models. We then augment the two models with a shortability-mimicking factor. Our results show that the factor has a significant power in explaining both time-series and cross-sectional variation in the size-B/M portfolio returns. The addition of the factor to the two models considerably increases their overall performance.

Keywords: Asset pricing models; Short-sales constraints; Shortability factor

JEL: G

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This study explores how the violation of free short selling assumption affects the performance of CAPM and the Fama-French three-factor model, as existing studies show that short-sales constraints affect asset pricing of the stocks. Using data from the Hong Kong Stock Market which has unique regulations on short selling, we conduct both time-series and cross-sectional regression analyses to evaluate the performance of the two models under the short-sales-constraints and the no-constraints market environment. The two models perform much worse in the former environment than in the latter, indicating a significant impact of the short sales constraints on the explanatory power of the models. We then augment the two models with a shortability-mimicking factor. Our results show that the factor has a significant power in explaining both time-series and cross-sectional variation in the size-B/M portfolio returns. The addition of the factor to the two models considerably increases their overall performance.

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1. Introduction

Many studies have shown that short-sales constraints affect asset pricing, such as causing overvaluation by preventing the stocks from incorporating negative information or pessimistic opinions into the prices (Miller, 1977; Chang, Cheng and Yu, 2007; Berkman et al., 2009; Diether et al., 2009; Boehmer and Wu, 2009), reducing the speed of price discovery by preventing informed investors from trading on bad news (Diamond and Verrecchia, 1987; Fung and Draper, 1999; Reed, 2007; Bris, Goetzmann, and Zhu, 2007; Chen and Rhee, 2010; Mashruwala and Mashruwala, 2014), and generating significant bubbles accompanied by large trading volumes and high price volatility (Scheinkman and Xiong 2003). However, despite the ample evidence on the impact of short-sales constraints on asset prices, it has never been incorporated in the typical asset pricing tests.

The CAPM has been the most widely-employed model [1]. Its underlying four assumptions of perfection in competitive markets[2] simplify the building of the model and permit one to consider only the mean and variance of the returns. It has been shown that the homogeneous-expectations assumption does not significantly affect the validity of the CAPM (Lintner, 1969). The normality and risk-averse-investor assumptions are generally regarded as an acceptable approximation to

[1]According to Welch (2008), about 75% of finance professors recommended using the CAPM. Graham and Harvey (2001) surveyed 392 CFOs within the US firms and find that 73.5% of the surveyed firms had always or almost always relied on the CAPM in estimating the cost of equity capital. The Wall Street Prep course in their training manual asserts that among several competing asset-pricing models, –The most popular and commonly used in practice is the capital asset pricing model (CAPM).‖ (p. 86).

[2]The four assumptions are: (1) homogeneous expectations from investors; (2) normal distribution of asset returns; (3) risk averse of individual investors who maximize the expected utility of their end of period wealth; and (4) absence of short-sales restrictions on any assets including risk-free asset.

reality (Black, 1972). However, Black (1972) argues that, among the assumptions, the absence of short-sales constraints is the most restrictive one. Regarding the FF three-factor model, an empirical extension of the CAPM and now becoming one of the standard benchmarks for performance evaluation (Cremers, Petajisto and Zitzewitz, 2010), it also assumes no short-sales restrictions when constructing the well-known small-minus-big (SMB) and high-minus-low (HML) factor portfolios.

In many markets, however, short-sales restrictions are present. According to Bris, Goetzmann and Zhu (2007), out of their 46 sample countries, 21 do not allow and/or do not practice short sales due to either restrictive regulations or huge costs on shorting stocks[3]. In fact, during the recent financial crisis period from 2007 to 2009, even many of the remaining 25 countries that used to allow short selling imposed short-selling bans on either the entire market or some sectors or individual stocks from time to time, including the US and most European countries (Beber and Pagano, 2013). The point made here is that the assumption of no short-selling restrictions underlying asset pricing models does not apply in many markets and/or at many time points. This poses an interesting question that whether the presence of the short-sales constraints would make much difference in terms of model performance. Surprisingly, no studies have ever formally tested it, which inspires us with the first objective of this study, that is, to investigate the extent to which the short-sales constraints would affect the performance of asset pricing models. In particular, we examine the performance of CAPM and FF three-factor model in two opposite short-selling environments. We find that, both models capture significantly more variation in stock returns when short selling is allowed than when it is banned, in both the time-series and the cross-sectional tests. For example, when we apply CAPM to explain the

[3] See Table 1 in Bris, Goetzmann and Zhu (2007) for detailed descriptions of the 46 countries.

time-series returns of shortable stocks, the average adjusted R^2 increases by more than 50% (from 38.4% to 58.4%) compared with the case when we apply the model to non-shortable stocks. With respect to the FF three-factor model, though the increase (from 61.0% to 65.0%, an increase of 6.56%) is not as dramatic as in the CAPM, it is still statistically significant.

Such finding, while indicating a significant deterioration in the explanatory power of the asset pricing models with the presence of the short-sales constraints, leads to our second objective—to improve the performance of the models with a shortability-mimicking factor in the markets with short-sales constraints/restrictions. This objective is motivated by the various risk factors already proposed in the literature and by their success in improving model performance. We propose a new risk factor (NMS) as the difference between the return on a portfolio of non-shortable stocks and the return on a portfolio of shortable stocks, and coin a term ―the shortability factor‖ to refer to it throughout the paper. We believe that NMS is a risk factor, as non-shortable stocks have higher risk hence higher expected excess returns than shortable stocks, for three reasons detailed below.

The first is related to the well-known over-pricing of the non-shortable stocks and disagreements between investors about the stocks' value. For convenience, we refer to the risk as the ―overvaluation risk‖. Short-sales constraints prevent the stocks from impounding negative information into, or reflecting pessimistic opinions in, their prices, leading to overvaluation. Once the constraints are lifted, their prices will decline, with constraint-induced upward price biases being corrected (Chang, Cheng and Yu, 2007; Berkman *et al*, 2009; Diether *et al*, 2009; and Boehmer and Wu, 2009). If there is overcorrection, the price drops would be even greater, overshooting the fundamental value. The higher the overvaluation, the worse will be the situation.

Thus, the uncertainty in the short-selling status of already constrained stocks is a risk for investors (whether informed or uninformed) holding them, relative to those investing in shortable stocks without significant and persistent overvaluation.

The second reason has to do with the liquidity of non-shortable stocks being low relative to that of shortable stocks. In other words, this liquidity risk is induced by short-sales constraints, and we refer to it as ―the constraint-induced liquidity risk‖. A short-selling ban reduces the speed of price discovery by preventing informed investors to trade on bad news, thereby increasing the information asymmetry component of bid-ask spread and reducing the liquidity of non-shortable stocks (Diamond and Verrecchia, 1987). A number of empirical studies have provided evidence in support of the theory (See, for example, Kolasinksi, Reed and Thornock, 2010; Boehmer, Jones and Zhang, 2013; and Bai and Qin, 2014). A drop in liquidity could be particularly detrimental to investors during a crisis when investors are in great need of liquidity. Thus, investors would require higher returns as compensation for taking on the risk of losses resulting from the lower liquidity caused by short-selling restrictions.

The third reason concerns what we call the ―constraint-induced information risk‖. Theory predicts that short-sales constraints lower the speed of price discovery for constrained stocks (Bai, Chang and Wang, 2006), and investors will view such a speed slowdown as loss of information efficiency. That is, a decline in the speed of price discovery entails not just liquidity risk but also information risk. Investors will therefore require higher returns on constrained stocks. The empirical literature provides evidence that non-shortable stocks do have a lower price discovery/adjustment speed than shortable stocks (Bris, Goetzmann and Zhu, 2007; Chen and Rhee, 2010; and Saffi and Sigurdsson, 2011).

Based on the above considerations, we augment the CAPM and the FF three-factor model with the shortability factor, and conjecture that the factor is priced. Following Fama and French (1993) who treat respectively the size factor and the value factor as a whole, we take the shortability factor as synthesizing the above-discussed ―overvaluation risk‖, ―constraint-induced liquidity risk‖ and ―constraint-induced information risk‖. If a risk premium is detected for the factor, this implies that investors require compensation for bearing the synthesised risk embodied in the factor. Our empirical results confirm our conjecture. For example, the time series tests show that for both CAPM and FF three-factor models, the augmented models with NMS factor produce significantly higher adjusted R^2 than the standard models without the factor; and the cross-sectional tests indicate that the risk premium for NMS is more significant than those for the market, size and book-to-market risk factors, both economically and statistically.

Our study contributes to the asset pricing literature in two aspects. First, it provides empirical evidence that the presence of short-sales constraints would lead to considerable decline in the performance of the CAPM and the FF three-factor model when applied to markets where shorting restrictions are present. That is, the two models are ―confined‖ by the assumption to work within the environment of no shorting restrictions. Nevertheless, by allowing for an additional factor related to short-sales constraints, the augmented models now work well in the environment with short-selling restrictions. Moreover, the augmented models also nest the standard models, in that, where short sales are allowed and practiced, the former would collapse to the latter.

Second, this study expands the extant set of risk factors with a new one that mimics short-sales constraints. Creating the new factor has three implications. First, it enables one to address the question of how to allow for the presence of short-sales constraints and how to modify asset pricing models accordingly. The second is related to the persistently higher returns on non-shortable stocks than on shortable stocks. Prior work fails to provide explanations, but our proposed new factor can offer one: The return difference could be due to a risk premium required by investors holding non-shortable stocks hence bearing some undiversifiable risk (such as the overvaluation risk, the constraint-induced liquidity risk and the constraint-induced information risk, as noted above). The third implication is that, when it comes to markets where short sales are not allowed, or even for the same markets during the periods of time when short selling is banned, there is an additional pattern in average returns that all the existing factor models cannot explain. This implication suggests that the presence of short-sales constraints could be one of the factors that contribute to the variation in the performance of asset pricing models across different countries and/or over time.

The rest of the paper is organized as follows. Section 2 describes the data. Section 3 introduces our methodology. In Section 4, we compare the performance of the CAPM between short-sales-constrained and short-sales-unconstrained stocks, and do the same to the FF three-factor model. In Section 5, we evaluate the shortability-augmented CAPM relative to the standard CAPM, and the shortability-augmented FF three-factor model relative to the standard FF three-factor model. We conclude our study in Section 6.

2. Data and factor construction

The uniqueness of Hong Kong's regulations on short sales provides an ideal laboratory for exploring the relative performance of an asset pricing model in opposite short-selling regimes (the ban and the no-ban regime), and enables us to construct the shortability risk factor. According to Table 1, at a point in time, a stock stays either on the official designated short-selling list or off the list. We therefore differentiate individual stocks into two groups: If a stock is on the list, we refer to it as –shortable‖; and if a stock is not on the list, we call it –non-shortable‖.

Constrained by data availability for constructing NMS, our *effective* sample period for sorting portfolios starts from January 1997 (instead of January 1994) and ends at February 2012. As of February 29, 2012, the designated short-selling list had been successively revised 102 times (since January 1994), and out of 1,498 common stocks traded on the Hong Kong Stock Exchange (HKSE), 1,081 were allowed to be sold short. To construct risk factors[4] and form portfolios, we collect the following data for each individual stock traded on the HKSE: closing prices, market value (ME), book value (BE) and the number of shares outstanding. We also obtain monthly Hong Kong 3-month Treasury bill rate (T-bill) as a proxy for risk-free rate. All these data come from the Datastream database.

As a usual practice, we proxy the market factor by excess market returns denoted as R_m- R_f. R_m is the return on the value-weighted portfolio of all shares traded on the HKSE, and R_f is the Hong Kong 3-month T-bill rate.

In constructing the size and book-to-market risk factors, we follow Fama and French (1992, 1993, 1996). Specifically, at the end of June of each year *t*, we sort all the stocks listed on the HKSE based on their market value (ME) and classify them into each of the two size groups: Stocks with ME above (below) the cross-sectional

[4] Risk factors for the Hong Kong stock market are not available from the Data Library website of Professor Kenneth French. So, we construct all of them, adopting the approach proposed by Fama and French (1992, 1993).

References

Asparouhova, E., Bessembinder, H., & Kalcheva, I. (2013). Noisy prices and inference regarding returns. *The Journal of Finance*, 68(2), 665-714.

Bai, Y., Chang, E. C., & Wang, J. (2006): Asset prices under short-sale constraints. Working paper.

Bai, M., & Qin, Y. (2014). Short-sales constraints and liquidity change: Cross-sectional evidence from the Hong Kong Market. *Pacific-Basin Finance Journal*, 26, 98-122.

Beber, A., & Pagano, M. (2013). Short Ëselling bans around the world: Evidence from the 2007–09 crisis. *The Journal of Finance*, 68(1), 343-381.

Berkman, H., Dimitrov,V., Jain, P.C., Koch, P. D., & Tice, S. (2009). Sell on the news: differences of opinion, short-sales constraints, and returns around earnings announcement. *Journal of Financial Economics* 92, 376-399.

Black, F. (1972). Capital market equilibrium with restricted borrowing. *Journal of Business* 45, 444-454.

Boehmer, E., Jones, C. M., & Zhang, X. (2013). Shackling short sellers: The 2008 shorting ban. *Review of Financial Studies*, 26(6): 1363-1400.

Boehmer, E., Wu, J., 2009. Short selling and the informational efficiency of Price. Unpublished manuscript. University of Oregon.

Bris, A., Goetzmann, W.N., & Zhu, N. (2007). Efficiency and the bear: short sales and markets around the world. *The Journal of Finance* 62, 1029-1079.

Chang, E. C., Cheng, J. W., & Yu, Y. (2007). Short Ësales constraints and price discovery: Evidence from the Hong Kong market. *The Journal of Finance*, 62(5), 2097-2121.

Chen, C. X., & Rhee, G. (2010). Short sales and speed of price adjustment: Evidence from the Hong Kong stock market. *Journal of Banking and Finance* 34, 471-483.

Cremers, M., Petajisto, A., & Zitzewitz, E. (2010): Should benchmark indices have alpha ÛRevisiting performance evaluation. Working paper.

Diamond, D. W., & Verrecchia, R. E., 1987. Constraints on short selling and asset price adjustment to private information, *Journal of Financial Economics* 18, 277-311.

Diether, K.B., Lee, K.-H., Werner, I. M., 2009. Short-sale strategies and return predictability. *Review of Financial Studies* 22, 575-607.

Fama, E. F., & French, K. R. (1992). The cross-section of expected stock returns. *The Journal of Finance* 47, 427-465.

Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics* 33, 3-56.

Fama, E. F., & French, K. R. (1996). Multifactor explanations of asset pricing anomalies. *The journal of finance*, 51(1), 55-84.

Fama, E.F., & MacBeth, J., (1973). Risk, return, and equilibrium: Empirical tests, *Journal of Political Economy* 81, 607-636.

Fung, J. K., & Draper, P. (1999). Mispricing of index futures contracts and short sales constraints. *Journal of Futures Markets*, 19(6), 695-715.

Gibbons, M. R., Ross, S. A., & Shanken, J. (1989). A test of the efficiency of a given portfolio. *Econometrica* 57, 1121-1152.

Graham, J. R., & Harvey, C. R. (2001). How do CFOs make capital budgeting and capital structure decisions? *Journal of Applied Corporate Finance* 15, 8-23.

Kolasinksi, A. C., Reed, A. V., & Thornock, J. R. (2010). Prohibitions versus constraints: The 2008 short sales regulations. University of Washington and University of North Carolina. Working paper,

Lewellen, J., Nagel, S, & Shanken, J., (2010). A sceptical appraisal of asset pricing tests. *Journal of Financial Economics* 96, 175-194.

Lintner, J. (1969). The aggregation of investors' diverse judgments and preferences in perfectly competitive security markets. *Journal of Financial and Quantitative Analysis* 4, 347-400.

Miller, E. M. (1977). Risk, uncertainty, and divergence of opinion. *The Journal of Finance* 32, 1151-1168.

Mashruwala, C., & Mashruwala, S. (2014). Is There a –Torpedo Effect‖ in Earnings Announcement Returns? The Role of Short-Sales Constraints and Investor Disagreement. *Journal of Accounting, Auditing & Finance*, 29(4), 519-546.

Reed, A. (2007). Costly short-selling and stock price adjustment to earnings announcements. University of North Carolina, unpublished manuscript.

Saffi, P. A., & Sigurdsson, K. (2011). Price efficiency and short selling. *Review of Financial Studies*, 24(3), 821-852.

Scheinkman, J., & Xiong, W. (2003). Overconfidence, short-sale constraints, and bubbles. *Journal of Political Economy*, 111, 1183-1219.

Shanken, J. (1985). Multivariate tests of the zero-beta CAPM. *Journal of Financial Economics* 14, 327–348.

Welch, I. (2008). The consensus estimate of the equity premium by academic financial economists in December 2007. *Working paper.*

Table 1: Changes in the Official Short-Selling List

This table provides information on changes in the official short-selling list of the HKSE from January 1994 to February 2012, including the effective date on which a change took place (–Change date‖), the numbers of stocks added to (–Addition‖) and deleted from (–Deletion‖) the list, and the total number of stocks appearing on the list (–No. of on-list stocks‖).

Change	Addition	Deletion	No. of on-list	Change	Addition	Deletion	No. of on-list	Change	Addition	Deletion	No. of on-list
3/01/1994	17	0	17	8/07/2005	1	0	265	14/11/2008	6	144	366
25/03/1996	96	0	113	15/07/2005	1	0	266	12/02/2009	25	27	364
1/05/1997	129	1	241	15/08/2005	14	12	268	14/05/2009	13	22	355
12/01/1998	69	0	310	5/09/2005	1	0	269	10/07/2009	1	0	356
16/03/1998	15	0	325	28/10/2005	1	0	270	5/08/2009	49	16	389
9/11/1998	19	149	195	18/11/2005	11	7	274	5/11/2009	58	11	436
1/03/1999	7	7	195	20/02/2006	10	8	276	18/11/2009	1	0	437
20/09/1999	3	17	181	1/03/2006	2	0	278	3/12/2009	1	0	438
12/11/1999	1	0	182	29/05/2006	23	17	284	15/12/2009	1	0	439
28/02/2000	24	12	194	2/06/2006	1	0	285	24/12/2009	1	0	440
31/05/2000	7	0	201	2/06/2006	1	0	286	1/02/2010	65	8	497
28/08/2000	32	16	217	25/08/2006	38	10	314	1/03/2010	1	0	498
12/02/2001	15	11	221	1/09/2006	1	0	315	10/03/2010	1	0	499
14/05/2001	6	0	227	23/10/2006	1	0	316	25/03/2010	1	0	500
20/08/2001	9	11	225	27/10/2006	1	0	317	10/05/2010	59	12	547
3/12/2001	17	85	157	1/12/2006	55	9	363	16/07/2010	1	0	548
25/02/2002	7	14	150	5/03/2007	30	24	369	4/08/2010	40	19	569
21/05/2002	11	6	155	14/03/2007	1	0	370	30/08/2010	1	0	570
29/07/2002	24	5	174	19/04/2007	5	0	375	29/10/2010	47	18	599
29/11/2002	6	15	165	26/04/2007	4	0	379	15/11/2010	1	0	600
27/01/2003	5	7	163	21/05/2007	29	14	394	22/11/2010	2	0	602
19/05/2003	18	7	174	21/05/2007	1	0	395	20/12/2010	1	0	603
21/07/2003	1	16	159	29/05/2007	1	0	396	30/12/2010	1	0	604
4/08/2003	0	1	158	4/07/2007	1	0	397	28/01/2011	1	0	605
3/11/2003	36	5	189	17/07/2007	1	0	398	1/02/2011	1	0	606
6/01/2004	1	0	190	13/08/2007	137	9	526	25/02/2011	70	17	659
10/02/2004	29	3	216	27/08/2007	1	0	527	24/05/2011	65	18	706
7/04/2004	1	0	217	26/11/2007	64	23	568	9/06/2011	1	0	707
27/04/2004	26	4	239	14/12/2007	2	0	570	12/07/2011	2	0	709
1/07/2004	1	0	240	14/12/2007	1	0	571	12/08/2011	24	50	683
9/07/2004	1	0	241	18/02/2008	33	41	563	6/09/2011	1	0	684
2/08/2004	8	21	228	13/03/2008	1	0	564	3/11/2011	18	97	605
8/11/2004	9	11	226	13/05/2008	22	47	539	14/11/2011	1	0	606
7/02/2005	15	7	234	15/05/2008	1	0	540	2/02/2012	2	0	608
1/03/2005	2	0	236	3/06/2008	5	0	545	10/02/2012	12	39	581
17/05/2005	37	9	264	7/08/2008	10	51	504	29/02/2012	1	0	582

Table 2: Summary Statistics for Risk Factors

We construct the market risk factor by using all Hong Kong shares and the all-share index is value weighted. SMB and HML are the risk factors associated with firm size and book-to-market ratio respectively.

We break all Hong Kong stock into two size groups based on the breakpoints for the bottom 50% (Small), and top 50% (Big) of the ranked values of ME. We also break all Hong Kong stocks into three book-to-market equity groups based on the breakpoints for the bottom 30%(Low), middle 40% (Medium), and top 30% (High) of the ranked values of BE/ME. Then we construct six portfolios (S/L,S/M,S/H,B/L,B/M,B/H) from the intersections of the two ME and three BE/ME groups. For example, the S/L portfolio contains the stocks in the small-ME group that are also in the low- BE/ME group, and the B/H portfolio contains the big-ME stocks that are also in the low-BE/ME group, and the B/H portfolio contains the big-ME stocks that also have high BE/MEs. Monthly value-weighted returns on the six portfolios are calculated from July of year t to June of t+1 (so the portfolios are formed/re-formed at June of t+1 and held for 12 months). We calculate returns beginning in July of year t to make sure that book equities for year t-1 are known. The size factor (SMB) is the average of the returns on the small-stock portfolios minus the returns on the big-stock portfolios:

¨Y ü ő ― (¨Yj ü ő j ü ¨Yj ü ő j ü ¨Yj˝O ő j˝O) / σ

Likewise, the B/M factor (HML) is the average of the returns on the high-B/M portfolios minus the returns on the low-B/M portfolios :

˝O ü ü ― (¨Yj˝O ¨Yj ü ő j˝O ő j ü) / ς

The NMS (shortable minus nonshortable) factors are constructed as: Each month, within each of the six Size-B/M portfolios, we calculate the difference in value-weighted returns of nonshortable and shortable portfolios, and then average the diffeences across the six portfolios:

ű ü ¨Y ρ/φ ¨Y7O ¨Y7O ő7O ő7O ¨Y7ü ¨Y7ü ő7ü ő7ü ¨Y7ü ¨Y7ü ő7ü ő7ü

	R_m - R_f	*SMB*	*HML*	*NMS*
Mean	-0.022	0.013	0.011	0.030
t-value for mean	-3.54	2.23	2.40	3.70
Median	-0.015	0.005	0.007	0.011
Maximum	0.215	0.504	0.543	0.746
Minimum	-0.440	-0.214	-0.122	-0.254
Standard Deviations	0.084	0.080	0.062	0.107
No. Obs	182	182	182	182

Table 3: Summary Statistics of Monthly Excess Returns for 25 Shortable and 25 Non-shortable Size-B/M Portfolios

At the end of June of each year, we construct 25 shortable size-B/M portfolios. The size breakpoints are the 20th, 40th, 60th, 80th percentiles of market capitalization. The B/M quintile breakpoints are 20th, 40th, 60th, 80th percentiles of the book-to-market ratio. The intersections of 5³ 5 independent size and B/M sorts for those shortable stocks produce 25 value-weighted size-B/M shortable portfolios. In the same way, we construct 25 non-shortable size-B/M portfolios. Sample period: January 1997 to February 2012 (with 182 monthly observations).

	Book-to-Market Equity (BE/ME) Quintiles										
Size	Low	2	3	4	High	Size	Low	2	3	4	High
	Panel A: Summary statistics for 25 shortable size-B/M portfolios										
	Mean						Standard deviation				
Small	-0.045	-0.045	-0.018	-0.017	-0.022	Small	0.170	0.166	0.170	0.153	0.169
2	-0.035	-0.024	-0.020	-0.022	-0.018	2	0.247	0.127	0.130	0.139	0.143
3	-0.032	-0.024	-0.013	-0.023	-0.012	3	0.140	0.119	0.124	0.133	0.145
4	-0.019	-0.017	-0.020	-0.023	-0.020	4	0.099	0.106	0.127	0.119	0.138
Big	-0.020	-0.019	-0.024	-0.020	-0.020	Big	0.087	0.094	0.107	0.108	0.134
	Panel B: Summary statistics for 25 non-shortable size-B/M portfolios										
	Mean						Standard deviation				
Small	0.024	0.008	0.003	0.017	0.036	Small	0.188	0.196	0.187	0.169	0.280
2	-0.017	0.009	0.005	0.004	0.001	2	0.185	0.189	0.122	0.144	0.127
3	-0.024	-0.011	-0.013	-0.007	-0.007	3	0.153	0.140	0.112	0.123	0.119
4	-0.031	-0.016	-0.019	-0.014	-0.016	4	0.138	0.106	0.126	0.100	0.127
Big	-0.027	-0.016	-0.007	-0.015	-0.010	Big	0.143	0.103	0.130	0.095	0.121

Panel C: Difference in the mean of returns between 25 shortable and 25 non-shortable size-B/M portfolios

	25 shortable size-B/M portfolios		25 non-shortable size-B/M portfolios
Mean	-0.023		-0.006
Differences		-0.0171	
t - differences		-4.33	

Table 4: Difference in CAMP Regressions between Shortable and Non-shortable Portfolios

This table only reports the differences in the estimated time-series coefficients between the model with 25 shortable size-B/M portfolios and the model with 25 non-shortable portfolios. ss_p = 1 indicates that portfolio *p* is formed using shortable stocks, while ss_p = 0 indicates that portfolio *p* is formed using non-shortable stocks. a_p measures the abnormal return. a'_p measures the difference in the abnormal return. b'_p measures the difference in the beta of the market factor. Sample period: January 1997 to February 2012 (with 182 monthly observations).

Time-series regression: $R_p - R_f = a_p + a'_p * ss_p + b_p*(R_m - R_f)+b'_p*ss_p*(R_m - R_f) + e_p$

Book-to-Market Equity (BE/ME) Quintiles

Size	Low	2	3	4	High	Size	Low	2	3	4	High
		a_p						$t(a_p)$			
Small	0.045	0.034	0.031	0.038	0.063	Small	3.778	2.865	2.830	3.759	3.950
2	0.010	0.036	0.024	0.024	0.024	2	0.695	3.808	3.282	2.938	3.248
3	0.003	0.011	0.006	0.014	0.014	3	0.398	1.553	1.021	1.971	1.927
4	-0.010	0.006	0.007	0.005	0.009	4	-1.407	1.090	1.087	1.003	1.322
Big	0.001	0.006	0.016	0.003	0.008	Big	0.210	1.382	2.681	0.626	1.171
		a'_p						$t(a'_p)$			
Small	-0.059	-0.052	-0.020	-0.026	-0.054	Small	-3.420	-3.027	-1.287	-1.841	-2.382
2	-0.017	-0.032	-0.018	-0.019	-0.014	2	-0.791	-2.413	-1.768	-1.593	-1.325
3	-0.006	-0.009	0.006	-0.009	0.002	3	-0.514	-0.914	0.650	-0.963	0.231
4	0.012	-0.001	0.001	-0.003	-0.001	4	1.275	-0.167	0.145	-0.351	-0.132
Big	0.000	-0.003	-0.016	-0.001	-0.001	Big	-0.047	-0.462	-1.892	-0.149	-0.085
		b'_p						$t(b'_p)$			
Small	0.246	0.077	0.073	0.327	0.206	Small	1.233	0.392	0.408	0.998	0.798
2	-0.072	-0.014	0.302	0.319	0.258	2	-0.290	-0.093	1.557	1.369	1.156
3	0.051	0.144	0.236	0.321	0.321	3	0.386	1.243	1.300	1.837	1.723
4	0.017	0.005	0.101	0.294	0.141	4	0.150	0.057	0.023	1.344	1.284
Big	-0.324	0.028	0.015	0.205	0.396	Big	-3.571	0.420	0.156	1.431	2.332
		R^2						adj R^2			
Small	0.284	0.326	0.375	0.353	0.232	Small	0.278	0.320	0.370	0.348	0.226
2	0.212	0.423	0.450	0.435	0.509	2	0.205	0.418	0.445	0.430	0.505
3	0.503	0.499	0.521	0.509	0.503	3	0.499	0.494	0.516	0.505	0.498
4	0.466	0.582	0.616	0.598	0.570	4	0.462	0.578	0.613	0.594	0.567
Big	0.629	0.707	0.566	0.569	0.483	Big	0.626	0.704	0.562	0.566	0.478

Table 5: Difference in the FF Three-Factor Regressions between Shortable and Non-shortable Portfolios

This table only reports the differences in the estimated time-series coefficients between the model with 25 shortable size-B/M portfolios and the model with non-shortable portfolios. ss_p = 1 indicates that portfolio p is formed using shortable stocks, while ss_p = 0 indicates that portfolio p is formed using non-shortable stocks. α_p measures the abnormal return. α'_p measures the difference in the abnormal return. b'_p measures the difference in the beta of the market factor. s'_p measures the difference in the beta of the size factor. h'_p measures the difference in the beta of the value factor. Sample period: January 1997 to February 2012 (with 182 monthly observations).

Time-series regression:

$$R_p - R_f = \alpha_p + \alpha'_p*ss_p + b_p*(R_m - R_f)+b'_p*ss_p*(R_m - R_f) + s_p*SMB + s'_p*ss_p*SMB + h_p*HML + h'_p*ss_p*HML + e_p$$

Book-to-Market Equity (BE/ME) Quintiles

Size	Low	2	3	4	High	Size	Low	2	3	4	High
		α_p						$t(\alpha_p)$			
Small	0.034	0.017	0.017	0.017	0.007	Small	3.146	1.627	1.744	1.942	0.666
2	-0.012	0.016	0.013	0.005	0.010	2	-0.877	1.869	1.908	0.815	1.701
3	-0.006	-0.002	-0.005	-0.002	-0.003	3	-0.761	-0.364	-0.853	-0.401	-0.555
4	-0.020	-0.004	-0.003	-0.006	-0.005	4	-3.383	-0.845	-0.562	-1.301	-0.851
Big	-0.006	-0.001	0.007	-0.004	-0.004	Big	-1.161	-0.315	1.235	-0.737	-0.676
		α'_p						$t(\alpha'_p)$			
Small	-0.058	-0.052	-0.021	-0.015	-0.012	Small	-3.629	-3.378	-1.514	-1.249	-0.753
2	-0.013	-0.016	-0.016	-0.009	-0.013	2	-0.652	-1.373	-1.699	-0.927	-1.489
3	0.001	0.000	0.010	-0.001	0.000	3	0.085	-0.056	1.270	-0.168	-0.023
4	0.022	0.008	0.009	0.006	0.007	4	2.578	1.219	1.168	0.822	0.834
Big	0.010	0.006	-0.008	0.005	0.003	Big	1.339	1.133	-0.983	0.674	0.370
		b'_p						$t(b'_p)$			
Small	0.188	-0.016	-0.019	0.323	0.511	Small	1.047	-0.093	-0.123	2.365	2.844
2	-0.103	0.024	0.270	0.343	0.249	2	-0.470	0.182	2.556	3.196	2.560
3	0.008	0.099	0.224	0.338	0.233	3	0.065	1.104	2.509	3.731	2.882
4	0.005	0.005	0.104	0.306	0.137	4	0.055	0.059	1.138	3.885	1.399
Big	-0.325	0.054	0.035	0.185	0.340	Big	-3.877	0.852	0.369	2.317	3.256
		s'_p						$t(s'_p)$			
Small	-0.376	-0.539	-0.529	-0.729	-0.725	Small	-2.030	-2.707	-3.309	-5.147	-3.884
2	-0.447	-0.784	-0.351	-0.471	-0.119	2	-1.978	-5.645	-3.211	-4.232	-1.175
3	-0.589	-0.838	-0.341	-0.415	-0.387	3	-4.532	-8.997	-3.682	-4.430	-4.615
4	-0.694	-0.601	-0.498	-0.454	-0.558	4	-6.883	-7.598	-5.239	-5.565	-5.504
Big	-0.656	-0.410	-0.385	-0.493	-0.683	Big	-7.555	-6.235	-3.900	-5.954	-5.763
		h'_p						$t(h'_p)$			
Small	0.261	0.771	0.508	-0.137	-2.263	Small	1.086	2.738	2.431	-0.740	-9.289
2	0.176	-0.440	0.143	-0.273	0.033	2	0.597	-2.425	1.000	-1.878	0.253
3	0.044	0.122	0.006	-0.203	0.513	3	0.236	1.002	0.051	-1.658	4.681
4	-0.077	-0.131	-0.134	-0.185	-0.099	4	-0.584	-1.268	-1.076	-1.732	-0.744
Big	-0.139	-0.269	-0.221	0.025	0.461	Big	-1.224	-3.125	-1.714	0.233	2.754
		R^2						adj R^2			
Small	0.445	0.493	0.561	0.572	0.648	Small	0.434	0.482	0.552	0.564	0.641
2	0.407	0.589	0.583	0.659	0.691	2	0.395	0.580	0.575	0.652	0.685
3	0.627	0.715	0.656	0.703	0.777	3	0.619	0.709	0.649	0.697	0.773
4	0.608	0.690	0.686	0.694	0.674	4	0.600	0.684	0.680	0.687	0.668
Big	0.700	0.752	0.619	0.633	0.622	Big	0.694	0.747	0.611	0.625	0.614

Table 6: Summary statistics for the time-series regressions of the CAPM and Fama-French three-factor models to explain monthly excess returns on, respectively, shortable and non-shortable size-B/M portfolios.

The GRS F-statistic tests whether all the 25 intercepts in each of the four time-series regressions are jointly zero. ¼a¼is the average absolute intercept. Avr R^2 is the average R^2. Avr $\bar{R}^2$ is the average adjusted R^2. We save 25 R-squares of shortable portfolios and 25 R-squares of non-shortable portfolios, and then use paired difference test to examine differences. We save 25 adjusted R-squares of shortable portfolios and 25 adjusted R-squares of non-shortable portfolios, and then use paired difference test to examine differences. The unexplained Sharpe ratio, $q_z(a)$, is the core component of the GRS F-statistic (the square root of the unexplained squared Sharpe ratio, $^{2}_{z}$). Sample period: January 1997 to February 2012 (with 182 monthly observations).

	Shortable portfolios						Non-shortable portfolios						Difference in Avr R^2 and Avr $\bar{R}^2$			
	GRS F	p-value	¼a¼	$q_z(a)$	Avr R^2	Avr $\bar{R}^2$	GRS F	p-value	¼a¼	$q_z(a)$	Avr R^2	Avr $\bar{R}^2$	R^2	t-value	Avr $\bar{R}^2$	t-value
CAPM	1.668	0.032	0.007	0.538	0.587	0.584	2.256	0.002	0.018	0.695	0.387	0.384	0.200	7.500	0.201	7.500
FF Three-Factor	1.310	0.163	0.006	0.497	0.657	0.650	1.713	0.029	0.009	0.631	0.617	0.610	0.040	2.720	0.040	2.720

Table 7: Cross-sectional regression tests

The table reports the OLS cross-sectional regression results (supplemented by the GLS R^2) with 25 size-B/M portfolios used alone or together with 33 industry portfolios as the LHS variables. The OLS R^2 is an adjusted R^2. The cross-sectional T^2 statistic tests whether pricing errors in a cross-sectional regression are all zero, with simulated p-values in brackets. *q* is the distance between a model's mimicking portfolios and the minimum-variance frontier, measured as the difference between the maximum generalized squared Sharpe ratio and that attainable from the mimicking portfolios. Ninety-five percent confidence intervals for the OLS R^2, the GLS R^2 and the q statistic are reported in brackets below their sample values. Each confidence interval is obtained by simulations with 40,000 replications. Coefficient estimates and their t-values (in parentheses) are computed according to Shanken and Zhou (2007). The sample period used in the first-pass regression is from January 1997 to February 2012, with 182 monthly observations.

Panel A								
CAPM (25)	***Const***	R_m - R_f			**OLS R^2**	**GLS R^2**	**T^2**	***q***
Shortable	-0.011	-0.010			-0.022	0.014	39.76	0.385
	-0.670	-0.700			[-0.043, 0.111]	[0.000,0.091]	[p=0.000]	[0.127, 0.390]
Non-shortable	-0.010	0.004			-0.042	0.017	69.33	0.801
	-0.420	0.180			[-0.043, 0.176]	[0.000, 0.096]	[p=0.000]	[0.825, 1.681]
Panel B								
CAPM (25+33)	***Const***	R_m - R_f			**OLS R^2**	**GLS R^2**	**T^2**	***q***
Shortable	-0.120	0.079			0.139	0.002	194.66	1.348
	-4.270	3.110			[-0.019,0.441]	[0.000, 0.010]]	[p=0.000]	[0.996, 1.482]
Non-shortable	-0.022	0.009			0.000	0.005	224.73	2.416
	-2.530	1.010			[-0.021,0.227]	[0.000, 0.012]	[p=0.000]	[2.664, 3.798]
Panel C								
FF 3-factor(25)	***Const***	R_m - R_f	***SMB***	***HML***	**OLS R^2**	**GLS R^2**	**T^2**	***q***
Shortable	-0.030	0.009	-0.012	0.000	0.042	0.029	28.91	0.340
	-1.440	0.470	-1.770	0.030	[-0.077, 0.595]	[0.004, 0.374]	[p=0.000]	[0.110, 0.348]
Non-shortable	-0.002	-0.029	0.029	0.008	0.474	0.153	39.22	0.626
	-0.100	-1.600	3.390	1.380	[0.096, 0.820]	[0.009, 0.482]	[p=0.000]	[0.209, 0.801]
Panel D								
FF 3-factor (25+33)	***Const***	R_m - R_f	***SMB***	***HML***	**OLS R^2**	**GLS R^2**	**T^2**	***q***
Shortable	-0.078	0.039	0.013	0.001	0.004	0.022	125.06	1.399
	-2.280	1.180	0.640	0.070	[-0.050, 0.242]	[0.002, 0.211]	[p=0.000]	[0.565, 1.309]
Non-shortable	-0.023	-0.006	0.018	0.015	0.265	0.127	168.89	2.217
	-3.06	-0.79	2.86	3.21	[0.004, 0.614]	[0.008,0.301]	[p=0.000]	[1.593, 2.510]

Table 8: Summary Statistics of Monthly Raw and Excess Returns on 25 Size-B/M Portfolios Sorted Using All Stocks
At the end of June of each year, we construct 25 size-B/M portfolios. The size breakpoints are the 20th, 40th, 60th, 80th percentiles of market capitalization. The B/M quintile breakpoints are 20th, 40th, 60th, 80th percentiles of book-to-market ratio. The intersections of the 5x5 independent size and B/M sorts for those stocks produce 25 monthly value-weighted size-B/M portfolios. Risk free rate is monthly Hong Kong 3-month Treasury bill rate.

Raw Return											
Size	Low	2	3	4	High	Size	Low	2	3	4	High
		Means						Standard Deviations			
Small	0.051	0.033	0.036	0.044	0.055	Small	0.175	0.153	0.156	0.153	0.224
2	0.011	0.026	0.019	0.023	0.027	2	0.149	0.165	0.107	0.119	0.125
3	0.005	0.013	0.009	0.017	0.016	3	0.151	0.109	0.108	0.122	0.120
4	0.001	0.007	0.015	0.013	0.013	4	0.108	0.102	0.110	0.123	0.112
Big	0.007	0.009	0.004	0.009	0.016	Big	0.083	0.088	0.100	0.103	0.139

Excess Return											
Size	Low	2	3	4	High	Size	Low	2	3	4	High
		Means						Standard Deviations			
Small	0.024	0.005	0.008	0.017	0.028	Small	0.178	0.157	0.159	0.157	0.226
2	-0.017	-0.002	-0.009	-0.005	-0.001	2	0.155	0.170	0.112	0.124	0.130
3	-0.023	-0.015	-0.018	-0.010	-0.012	3	0.154	0.114	0.115	0.128	0.126
4	-0.027	-0.021	-0.013	-0.015	-0.015	4	0.113	0.109	0.117	0.131	0.118
Big	-0.021	-0.019	-0.023	-0.019	-0.012	Big	0.089	0.094	0.107	0.110	0.143

Table 9: Summary Statistics for Time-Series Regressions Based on the CAPM to Explain Monthly Excess Returns on 25 Size-B/M Portfolios

The 25 size-B/M portfolios are constructed using all stocks without differentiating them into the shortable and the non-shortable group. a_p measures the abnormal return. b_p measures the beta of the market factor. The sample period used for regressions is from January 1997 to February 2012, with 182 monthly observations.

Time-series regressions:

$$R_{pt} - R_{ft} = a_p + b_p\left(R_{mt} - R_{ft}\right) + e_{pt}$$

Book-to-Market Equity (BE/ME) Quintiles

Size	Low	2	3	4	High	Size	Low	2	3	4	High
		a_p							$t(a_p)$		
Small	0.045	0.024	0.029	0.041	0.054	Small	3.721	2.216	2.759	4.112	3.440
2	0.008	0.026	0.010	0.017	0.025	2	0.850	2.485	1.551	2.351	3.574
3	-0.003	0.008	0.005	0.013	0.013	3	-0.243	1.453	0.906	1.856	1.990
4	-0.004	0.003	0.013	0.012	0.009	4	-0.680	0.669	2.648	1.837	1.543
Big	0.001	0.004	0.001	0.006	0.016	Big	0.178	1.417	0.241	1.412	2.139
		b_p							$t(b_p)$		
Small	0.972	0.842	0.953	1.075	1.187	Small	6.926	6.765	7.817	9.445	6.565
2	1.124	1.241	0.863	0.982	1.132	2	10.279	10.416	11.445	11.892	14.326
3	0.910	1.031	1.053	1.056	1.121	3	7.625	15.695	16.141	12.882	14.958
4	1.036	1.072	1.166	1.189	1.081	4	16.062	19.923	20.722	15.940	16.305
Big	0.950	1.023	1.102	1.120	1.253	Big	28.024	31.025	23.143	22.332	14.492
		R^2							Adj R^2		
Small	0.212	0.205	0.256	0.334	0.195	Small	0.208	0.200	0.251	0.330	0.190
2	0.372	0.379	0.424	0.443	0.536	2	0.369	0.375	0.421	0.440	0.533
3	0.246	0.581	0.594	0.482	0.557	3	0.242	0.578	0.592	0.480	0.554
4	0.592	0.690	0.707	0.588	0.599	4	0.589	0.689	0.705	0.586	0.597
Big	0.815	0.844	0.751	0.737	0.541	Big	0.814	0.843	0.749	0.735	0.539

Table 10: Summary Statistics for Time-Series Regressions Based on the CAPM Augmented with the Shortability Factor to Explain Monthly Excess Returns on 25 Size-B/M Portfolios

The 25 size-B/M portfolios are constructed using all stocks without differentiating them into the shortable and the non-shortable group. a_p measures the abnormal return. b_p measures the beta of the market factor. n_p measures the beta of the shortability factor. The sample period used for regressions is from January 1997 to February 2012, with 182 monthly observations.

Time-series regressions:

$$R_{pt} - R_{ft} = a_p + b_p(R_{mt} - R_{ft}) + n_p NMS_t + e_{pt}$$

Book-to-Market Equity (BE/ME) Quintiles

Size	Low	2	3	4	High	Size	Low	2	3	4	High
			a_p						$t(a_p)$		
Small	0.014	0.003	0.005	0.018	0.013	Small	1.639	0.318	0.589	2.301	1.198
2	-0.002	-0.003	-0.003	-0.001	0.008	2	-1.545	-0.449	-0.578	-0.238	1.586
3	-0.003	-0.003	-0.006	0.002	0.000	3	-2.528	-0.675	-1.131	0.234	0.026
4	-0.005	-0.003	0.007	0.003	0.000	4	-2.974	-0.953	1.481	0.522	0.015
Big	0.002	0.006	0.004	0.008	0.011	Big	0.734	1.909	1.068	1.803	1.406
			b_p						$t(b_p)$		
Small	0.992	0.855	0.968	1.090	1.214	Small	10.227	8.215	10.454	12.667	9.948
2	1.137	1.260	0.872	0.994	1.143	2	13.012	17.108	14.141	17.211	19.368
3	0.923	1.038	1.060	1.064	1.129	3	9.250	19.272	19.222	14.624	18.120
4	1.043	1.076	1.169	1.195	1.087	4	19.195	22.243	22.062	17.260	18.146
Big	0.949	1.022	1.099	1.119	1.257	Big	28.288	31.274	23.705	22.419	14.794
			n_p						$t(n_p)$		
Small	1.063	0.717	0.831	0.782	1.399	Small	13.987	8.791	11.452	11.603	14.634
2	0.691	0.981	0.457	0.619	0.552	2	10.089	17.008	9.457	13.682	11.938
3	0.689	0.395	0.367	0.400	0.438	3	8.812	9.359	8.497	7.014	8.969
4	0.366	0.249	0.201	0.296	0.301	4	8.598	6.557	4.847	5.459	6.419
Big	-0.058	-0.053	-0.118	-0.066	0.183	Big	-2.197	-2.064	-3.249	-1.685	2.743
			R^2						Adj R^2		
Small	0.626	0.446	0.572	0.622	0.636	Small	0.622	0.440	0.568	0.617	0.632
2	0.602	0.764	0.617	0.729	0.743	2	0.597	0.761	0.613	0.726	0.740
3	0.476	0.719	0.712	0.595	0.695	3	0.470	0.716	0.708	0.590	0.692
4	0.712	0.751	0.741	0.647	0.675	4	0.709	0.748	0.738	0.643	0.671
Big	0.820	0.848	0.765	0.741	0.560	Big	0.818	0.846	0.762	0.738	0.555

Table 11: Summary Statistics for Time-Series Regressions Based on the FF Three-Factor Model to Explain Monthly Excess Returns on 25 Size-B/M Portfolios

The 25 size-B/M portfolios are constructed using all stocks without differentiating them into the shortable and the non-shortable group. a_p measures the abnormal return. b_p measures the beta of the market factor. s_p measures the beta of the size factor. h_p measures the beta of the value factor. The sample period used for regressions is from January 1997 to February 2012, with 182 monthly observations.

Time-series regressions:

$$R_{pt} - R_{ft} = a_p + b_p\left(R_{mt} - R_{ft}\right) + s_p SMB_t + h_p HML_t + e_{pt}$$

Book-to-Market Equity (BE/ME) Quintiles

Size	Low	2	3	4	High	Size	Low	2	3	4	High
			a_p						$t(a_p)$		
Small	0.030	0.011	0.015	0.022	0.008	Small	3.086	1.113	1.680	2.982	0.900
2	-0.005	0.008	-0.002	0.000	0.009	2	-0.758	1.047	-0.348	0.084	1.929
3	-0.017	-0.001	-0.004	0.001	-0.003	3	-1.977	-0.169	-0.957	0.179	-0.544
4	-0.012	-0.005	0.003	0.001	-0.004	4	-2.673	-1.130	0.699	0.129	-0.876
Big	0.003	0.005	-0.001	0.003	-0.002	Big	1.12733	1.80896	-0.20089	0.71306	-0.449
			b_p						$t(b_p)$		
Small	1.020	0.842	0.964	1.056	0.954	Small	9.129	7.541	9.358	12.466	9.917
2	1.169	1.253	0.852	0.951	1.095	2	15.186	15.350	14.958	18.642	21.043
3	0.912	1.038	1.048	1.036	1.061	3	9.142	20.954	20.436	15.378	20.063
4	1.033	1.049	1.109	1.154	1.014	4	19.535	22.513	23.685	18.016	19.484
Big	0.965	1.021	1.056	1.068	1.069	Big	28.801	30.735	23.429	22.460	19.774
			s_p						$t(s_p)$		
Small	1.251	0.828	0.959	1.045	1.485	Small	10.809	7.157	8.985	11.915	14.889
2	1.122	1.229	0.683	0.851	0.763	2	14.069	14.525	11.578	16.099	14.151
3	0.951	0.618	0.568	0.640	0.610	3	9.210	12.041	10.688	9.174	11.130
4	0.528	0.351	0.282	0.489	0.398	4	9.632	7.273	5.809	7.363	7.389
Big	-0.087	-0.089	-0.171	-0.125	0.002	Big	-2.510	-2.579	-3.659	-2.527	0.034
			h_p						$t(h_p)$		
Small	-0.048	0.181	0.132	0.369	1.927	Small	-0.315	1.194	0.948	3.216	14.769
2	-0.063	0.192	0.230	0.402	0.425	2	-0.601	1.732	2.984	5.818	6.020
3	0.199	0.087	0.161	0.286	0.543	3	1.474	1.297	2.312	3.134	7.568
4	0.138	0.232	0.452	0.350	0.548	4	1.932	3.678	7.130	4.031	7.769
Big	-0.118	-0.008	0.274	0.329	1.262	Big	-2.607	-0.179	4.483	5.102	17.223
			R^2						Adj R^2		
Small	0.527	0.392	0.495	0.651	0.784	Small	0.519	0.382	0.487	0.645	0.780
2	0.705	0.724	0.689	0.798	0.809	2	0.700	0.719	0.683	0.795	0.806
3	0.501	0.774	0.762	0.669	0.791	3	0.492	0.770	0.758	0.664	0.787
4	0.740	0.780	0.808	0.712	0.766	4	0.735	0.776	0.804	0.707	0.762
Big	0.829	0.850	0.788	0.776	0.830	Big	0.826	0.847	0.784	0.772	0.827

Table 12: Summary Statistics for Time-Series Regressions Based on the FF Three-Factor Model Augmented with the Shortability Factor to Explain Monthly Excess Returns on 25 Size-B/M portfolios

The 25 size-B/M portfolios are constructed using all stocks without differentiating them into the shortable and the non-shortable group. a_p measures the abnormal return. b_p measures the beta of the market factor. s_p measures the beta of the size factor. h_p measures the beta of the value factor. n_p measures the beta of the shortability factor. The sample period used for regressions is from January 1997 to February 2012, with 182 monthly observations.

Time-series regressions:

$$R_{pt} - R_{ft} = a_p + b_p\left(R_{mt} - R_{ft}\right) + s_p SMB_t + h_p HML_t + n_p NMS_t + e_{pt}$$

Book-to-Market Equity (BE/ME) Quintiles

Size	Low	2	3	4	High	Size	Low	2	3	4	High
			a_p						t(a_p)		
Small	0.013	0.000	0.002	0.021	-0.005	Small	1.445	0.019	0.230	2.686	-0.646
2	0.002	-0.002	0.002	0.002	0.011	2	0.224	-0.299	0.369	0.375	2.335
3	-0.018	0.003	-0.001	0.008	0.002	3	-1.990	0.658	-0.117	1.306	0.332
4	-0.011	-0.003	0.007	0.008	-0.001	4	-2.325	-0.664	1.683	1.444	-0.149
Big	0.002	0.004	0.002	0.005	-0.005	Big	0.632	1.482	0.496	1.066	-1.023
			b_p						t(b_p)		
Small	1.041	0.855	0.981	1.057	0.970	Small	10.891	8.044	10.462	12.468	11.150
2	1.161	1.265	0.847	0.949	1.093	2	15.673	16.731	15.165	18.621	21.119
3	0.912	1.034	1.044	1.028	1.056	3	9.125	21.422	20.903	16.046	20.573
4	1.032	1.047	1.104	1.145	1.010	4	19.502	22.580	24.493	19.143	19.781
Big	0.966	1.022	1.053	1.066	1.073	Big	29.037	30.764	23.775	22.485	20.072
			s_p						t(s_p)		
Small	-0.866	-0.452	-0.621	0.866	-0.032	Small	-3.095	-1.452	-2.265	3.489	-0.126
2	1.914	0.088	1.114	1.012	1.019	2	8.826	0.396	6.812	6.787	6.728
3	0.862	1.050	1.019	1.419	1.096	3	2.947	7.431	6.974	7.573	7.293
4	0.678	0.569	0.760	1.338	0.794	4	4.378	4.196	5.762	7.639	5.311
Big	-0.255	-0.186	0.162	0.068	-0.336	Big	-2.619	-1.908	1.250	0.487	-2.146
			h_p						t(h_p)		
Small	-0.444	-0.059	-0.164	0.335	1.642	Small	-3.209	-0.384	-1.207	2.730	13.029
2	0.086	-0.022	0.311	0.432	0.473	2	0.798	-0.203	3.843	5.856	6.305
3	0.183	0.168	0.245	0.432	0.634	3	1.260	2.403	3.391	4.658	8.519
4	0.167	0.273	0.542	0.509	0.622	4	2.174	4.068	8.301	5.873	8.409
Big	-0.150	-0.026	0.336	0.365	1.199	Big	-3.108	-0.544	5.243	5.311	15.486
			n_p						t(n_p)		
Small	1.713	1.036	1.279	0.145	1.228	Small	8.089	4.398	6.161	0.773	6.370
2	0.640	0.923	0.349	0.131	0.207	2	3.902	5.514	2.817	1.159	1.805
3	0.072	0.349	0.365	0.631	0.393	3	0.325	3.265	3.301	4.445	3.457
4	0.121	0.177	0.387	0.687	0.320	4	1.035	1.719	3.877	5.183	2.827
Big	0.136	0.078	-0.269	-0.155	0.273	Big	1.844	1.064	-2.746	-1.480	2.308
			R^2						Adj R^2		
Small	0.656	0.453	0.585	0.652	0.824	Small	0.648	0.440	0.576	0.644	0.820
2	0.729	0.765	0.702	0.800	0.813	2	0.722	0.759	0.695	0.795	0.808
3	0.501	0.787	0.776	0.703	0.804	3	0.490	0.782	0.771	0.696	0.799
4	0.741	0.783	0.823	0.750	0.776	4	0.736	0.778	0.819	0.745	0.771
Big	0.832	0.851	0.797	0.779	0.835	Big	0.829	0.847	0.792	0.774	0.831

Table 13: Cross-sectional regression tests

The table reports the OLS cross-sectional regression results (supplemented by the GLS R^2) with 25 size-B/M portfolios used alone or together with 33 industry portfolios as the LHS variables. The OLS R^2 is an adjusted R^2. The cross-sectional T^2 statistic tests whether pricing errors in a cross-sectional regression are all zero, with simulated p-values in brackets. *q* is the distance that a model's mimicking portfolios are from the minimum-variance frontier, measured as the difference between the maximum generalized squared Sharpe ratio and that attainable from the mimicking portfolios. Ninety-five percent confidence intervals for the OLS R^2, the GLS R^2, and the *q* statistic are reported in bracket below their sample values. Each confidence interval is obtained by simulations with 40,000 replications. Coefficient estimates and their t-values (in parentheses) are computed according to Shanken and Zhou (2007). The sample period used in the first-pass regression is from January 1997 to February 2012, with 182 monthly observations.

CAPM	***Const***	***R_m - R_f***	***NMS***			**OLS R^2**	**GLS R^2**	**T^2**	**q**
FF25	-0.006	-0.002				-0.043	0.005	99.82	0.701
	(-0.20)	(-0.08)				[-0.043, 0.165]	[0.000, 0.210]	[p=0.009]	[0.071, 0.732]
FF25	-0.026	0.002	0.031			0.616	0.193	61.43	0.455
	(-1.30)	(0.12)	(6.36)			[0.297, 0.851]	0.030, 0.296]	[p=0.125]	[0.000, 0.432]
FF25+33ind.	-0.042	0.022				0.001	0.001	211.30	1.428
	(-1.88)	(1.03)				[-0.019, 0.132]	[0.000, 0.011]	[p=0.000]	[0.693, 1.499]
FF25+33ind.	-0.028	-0.001	0.035			0.249	0.009	149.81	1.163
	(-1.38)	(-0.03)	(3.88)			[0.065, 0.534]	[0.002, 0.010]	[p=0.000]	[0.308, 1.098]
FF 3-factor	***Const***	***R_m - R_f***	***SMB***	***HML***	***NMS***	**OLS R^2**	**GLS R^2**	**T^2**	***q***
FF25	-0.004	-0.020	0.021	0.009		0.529	0.103	69.53	0.603
	(-0.16)	(-0.89)	(4.61)	(1.95)		[0.214, 0.826]	[0.030, 0.438]	[p=0.139]	[0.000, 0.510]
FF25	-0.019	-0.002	0.014	0.008	0.030	0.710	0.401	39.48	0.354
	(-0.99)	(-0.09)	(3.47)	(2.05)	(6.88)	[0.424, 0.925]	[0.101, 0.622]	[p=0.593]	[0.000, 0.297]
FF25+33ind.	-0.020	-0.011	0.024	0.012		0.242	0.021	182.91	1.225
	(-0.98)	(-0.55)	(3.45)	(1.25)		[0.049, 0.487]	[0.009, 0.119]	[p=0.000]	[0.299, 1.210]
FF25+33ind.	-0.012	-0.020	0.028	0.012	0.033	0.354	0.128	130.23	1.003
	(-0.63)	(-1.05)	(4.13)	(1.30)	(3.70)	[0.117, 0.628]	[0.030, 0.198]	[p=0.005]	[0.009, 0.974]