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Fama–French in China: Size and Value Factors in Chinese Stock Returns*

GRACE XING HU[†,‡], CAN CHEN[§], YUAN SHAO[§] AND JIANG WANG[‡,¶,||]
[†]School of Economics and Finance, University of Hong Kong, Hong Kong
[‡]CAFR, Shanghai, P.R. China
[§]Shanghai Advanced Institute of Finance, Shanghai Jiao Tong University, Shanghai, P.R. China
[¶]MIT, Sloan School of Management, Cambridge, MA, USA and
[||]NBER, Cambridge, MA, USA

ABSTRACT

We investigate the size and value factors in the cross-section of returns for the Chinese stock market. We find a significant size effect but no robust value effect. A zero-cost small-minus-big (SMB) portfolio earns an average premium of 0.61% per month, which is statistically significant with a *t*-value of 2.89 and economically important. In contrast, neither the market portfolio nor the zero-cost high-minus-low (HML) portfolio has average premiums that are statistically different from zero. In both time-series regressions and Fama–MacBeth cross-sectional tests, SMB represents the strongest factor in explaining the cross-section of Chinese stock returns. Our results contradict several existing studies which document a value effect. We show that this difference comes from the extreme values in a few months in the early years of the market with a small number of stocks and high volatility. Their impact becomes insignificant with a longer sample and proper volatility adjustment.

JEL Codes: G10; G12; G15

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I. INTRODUCTION

A large body of asset pricing literature has been devoted to document and explain cross-sectional stock returns beyond the classic Capital Asset Pricing Model (CAPM). Earlier papers include Stattman (1980), Banz (1981, 1983), and Chan et al. (1991), which found empirical cross-sectional return patterns

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inconsistent with the CAPM. In two influential papers, Fama and French (1992, 1993), the authors showed that size, as measured by market capitalization, and value, as measured by the book-to-market ratio, are the two most significant factors in explaining the cross-sectional returns in the US stock market. Since then, size and value premiums have become two of the most widely used "asset-pricing" factors in the United States and global equity markets.[1]

There has been limited study on the cross-sectional returns in the Chinese stock market, even though it has quickly grown to be the second largest in the world by market capitalization.[2] Research has been hindered by the lack of high quality data and by the short history of the market. Existing work relies on data of varied quality and sample periods and obtains results often inconsistent with each other.[3] Such a situation is particularly unsatisfying as most empirical work on the Chinese stock market needs an empirical pricing model to benchmark risk and returns. Taking advantage of a complete database recently put together, we hope to provide a more definitive empirical calibration of the return factors in the Chinese stock market.

In particular, we examine the role of size and value factors in explaining the cross-sectional returns in the Chinese A-share market from its beginning in 1990–2016. Our benchmark sample period is from July 1995 to December 2016, which contains enough number of stocks in the cross-section. We find that size is strongly associated with cross-sectional returns. The average returns on the 10 portfolios formed on the basis of market capitalization show a robust negative relationship with the underlying stocks' size. The average return on the smallest size decile is 1.84% per month during the period, versus 0.10% on the largest size decile. A long-short portfolio which longs the smallest size portfolio and shorts the largest size portfolio earns an average return of 1.23% per month, not only economically large but also strongly significant at the 1% level. Moreover, the observed relationship between stock returns and firm size cannot be explained by the market factor, as the market beta is flat across the 10 size-sorted portfolios. By comparison, we observe no pattern in the average returns of the 10 book-to-market (B/M)-sorted portfolios. A long-short portfolio which longs the highest B/M ratios portfolio and shorts the lowest B/M ratios portfolio earns an average return of 0.38% per month with a *t*-value of only 1.51, which is not statistically significant from zero.

We then follow the methodology in Fama and French (1993) to construct two zero-cost portfolios, small-minus-big (SMB), and high-minus-low (HML), to

1 Studies of non-US markets Fama and French (2012), Brückner et al. (2014), Michou et al. (2013), Veltri and Silvestri (2011), Moerman (2005), Nartea et al. (2008), Chou et al. (2012), Docherty et al. (2013), Cordeiro and Machado (2013), Agarwalla et al. (2013), Drew and Veeraraghavan (2002), among others.

2 See, for example, monthly report for 2014 by the World Federation of Exchanges.

3 These papers include Cakici, Chan, and Topyan (2015a), Chen et al. (2010), Carpenter et al. (2014), Wang and Xu (2004), Cakici, Chatterjee, and Topyan (2015b), Hilliard and Zhang (2015), Cheung et al. (2015), Wang and Di Iorio (2007), Wong et al. (2006), Wu (2011), Eun and Huang (2007), Huang and Yang (2011), Chen et al. (2007), Morelli (2012), and so forth. We will discuss these papers in more detail later.

mimic risk factors related to size and value in the Chinese stock market. Over our sample period, SMB earns an average return of 0.61% per month, or 7.32% per year. The average return of SMB is not only economically large but also strongly significant with a *t*-value of 2.89. In contrast, neither the market portfolio $R_M - R_f$ nor the factor mimicking portfolio HML has significant average returns during the same sample period. The average excess return of the market portfolio is 0.52% per month with a *t*-value of 1.22; the average return of HML is 0.23% per month with a *t*-value of 1.40. The dominant performance of SMB over the market portfolio and HML implies that size is likely to be important in explaining cross-sectional returns, while the market portfolio and HML are not.

For formal asset pricing tests, we employ both the time-series and the Fama–MacBeth regressions. In the time-series regression, we first form 25 portfolios on the basis of size and book-to-market ratio. There is a large dispersion in the average excess returns across the 25 portfolios, ranging from –0.58% per month to 1.94% per month. Among them, nine portfolios have significant positive average excess returns. We then regress the excess returns of the 25 stock portfolios on the market portfolio $R_M - R_f$ and the two factor mimicking portfolios SMB and HML.

The time-series regression results show that the three factors capture strong common variations in the stock returns of the 25 portfolios, as reflected in the significant slopes on the three risk factors and the high R^2 values of the regressions. More important, judging on the basis of the intercepts of the time-series regressions, the three factors together successfully capture the cross-sectional variations in average returns on the 25 portfolios. The remaining intercepts, that is, the αs, of the regressions of the excess returns on the 25 portfolios on the three factors, $R_M - R_f$, SMB, and HML, are small in magnitude, ranging from –0.36% to 0.46% per month. Using the Gibbons–Ross–Shanken test, we obtain a *F*-statistic of 1.42 with *p*-value 0.79 and therefore cannot reject the hypothesis that the intercepts across the 25 portfolios are jointly zero.

Moreover, the three factors contribute differently to the reduction of αs. Using the market factor $R_M - R_f$ alone, the intercepts remain strongly significant and widely dispersed. Twelve out of the 25 portfolios still have positive intercepts that are significant from zeros and two portfolios have negative significant intercept. Similarly, HML also plays a weak role in explaining cross-sectional returns. Whether used alone or in combination with the market factor, the intercepts of majority portfolios in the bottom three size quintiles remain large and statistically significant. In contrast, SMB, when used as the sole risk factor, can make the intercepts of all portfolios statistically insignificant from zeros. Putting all evidence together, it is clear that SMB is the most important factor in explaining the cross-sectional variations in average stock returns.

We then perform the Fama–MacBeth regression to estimate the risk premiums associated with the market, SMB, and HML factors. The results are consistent with the time-series regression findings. SMB is estimated to have a risk premium of 0.96% per month, strongly positively significant with a *t*-value of

4.39. The positive risk premium associated with SMB is also robust to the inclusion of various accounting variables. By comparison, the market factor $R_M - R_f$ and the HML factor do not carry significant risk premiums. The estimated risk premium for the market factor is –0.83% with a *t*-value of –0.90; the estimated risk premium for HML is 0.17% with a *t*-value of 1.11.

To summarize, we find strong size effect but no robust value effect cross returns in China's stock market. While the existing literature agrees on the strong size effect, the findings on the value effect are mixed. For example, Wang and Xu (2004) and Hilliard and Zhang (2015) find no value effect, while other papers such as Cakici et al. (2015a), Chen et al. (2010), Carpenter et al. (2014), Cakici et al. (2015b), Cheung et al. (2015), document significant value effect.[4]

The discrepancies in the empirical findings highlight the challenges of performing cross-sectional tests for the Chinese stock market, which has a much shorter history than other more mature markets. We find that the standard methods used in the literature are often subject to serious small sample biases. To reduce these biases, we design improved methods better suited for the Chinese stock market, which exhibits large time variation in volatility.

First, instead of simple time-series averages, we use variance adjusted average returns, to estimate a portfolio's expected returns. Diverging from the traditional assumption of identical and independent distributions (iid), we assume that returns observed at each month share the same mean but have different variance. To better estimate the common mean, which is the expected return, we assign relatively lower weights to returns observed at high variance (low precision) months and higher weights to returns observed at low variance (high precision) months. In the same spirit, we also extend the standard Fama–MacBeth regressions to take into account the different dispersions associated with the estimated slopes at each month. In both approaches, we can effectively reduce the noise caused by extreme observations at times when the market is very volatile. Consequently, the value effect is no longer significant.

Despite the consistent results we find through different tests, it is fair to point out that the relatively short sample and the substantial time variation in market conditions of the Chinese stock market should make us cautious about the robustness of any empirical results regarding its risk premiums. From this perspective, instead of referring to the findings in this paper as definitive in support of a particular empirical asset pricing model, it is probably more sensible to view it as a note of caution in applying any of these models for the Chinese stock market.

The rest of paper is organized as follows. Section II gives a short summary of China's stock market. Section III describes the data we use for this paper. Section IV discusses the cross-sectional returns related to size and book-to-

4 Other papers that have find signficant value effect include: Wang and Di Iorio (2007), Wong et al. (2006), Wu (2011), Eun and Huang (2007), Huang and Yang (2011), Chen et al. (2007), and Morelli (2012).

market ratio. Section V performs formal asset-pricing tests on the two factor mimicking portfolios SMB and HML. Section VI conducts several robustness checks. Section VII concludes the paper.

II. BACKGROUND ON CHINA'S STOCK MARKET

The contemporary Chinese stock market is marked by the founding of two major exchanges, the Shanghai Stock Exchange (SSE) and the Shenzhen Stock Exchange (SZSE), in 1990. Despite its short history, China's stock market has experienced rapid growth. Figure 1 shows the number of stocks and total market capitalization of the SSE and SZSE from 1990 to 2016.[5] A more comprehensive summary of the history of China's stock market and its empirical properties are discussed in Wang et al. (2014).

Starting with only eight stocks listed on Shanghai and six listed on Shenzhen in 1990, the number of stocks on the two exchanges rose to 311 by the end of 1995, 720 by 1997, 1060 by 2000, and 3034 by 2016. The two exchanges shared a similar growth path in terms of the number of stocks until 2004, when the Shenzhen exchange expanded more quickly with the creation of the Small and Medium Enterprise (SME) board. The introduction of the Growth Enterprise Market (GEM) later at 2009 also substantially increased the number of stocks on the Shenzhen exchange. By the end of 2016, the number of stocks listed on the SZSE has reached 1859, 58% more than that on the Shanghai exchange. Though with multiple boards and significantly more stocks, the total market capitalization of the Shenzhen exchange is still less than that of Shanghai since firms listed on the Shenzhen exchange are usually smaller companies. The total market capitalization of the two exchanges combined together reached to around 40 trillion RMB (around 6 trillion USD) by the end of 2016, putting China in second place globally, only after the United States.

The Chinese stock market is marked by a number of unique characteristics. One feature is the coexistence of different share classes. There are three types of shares in China's stock market: A, B, and H shares. A shares are denominated in renminbi (RMB) and are open mostly to domestic investors. B shares, usually denominated in US dollars on the SSE and Hong Kong dollars on the SZSE, are mainly for foreign investors. Domestic investors are restricted from investing abroad, and foreign investors are restricted from investing in the A-share market in mainland China. However, the issuance and trading activities in the B-share market have decreased sharply recently, due to various programs that relax the cross-trading restrictions. By the end of 2016, there are only around 100 listed companies with B shares traded on the SSE and SZSE, accounting for only a tiny proportion of the total market. H shares, dominated in Hong Kong dollars, refer to shares of companies registered in mainland China but listed and traded on

5 The total number of stocks counts only the A-shares listed on Shanghai and Shenzhen stock exchanges. The total market capitalization is calculated based on floating A-shares only. The datasource is from WIND, Inc.

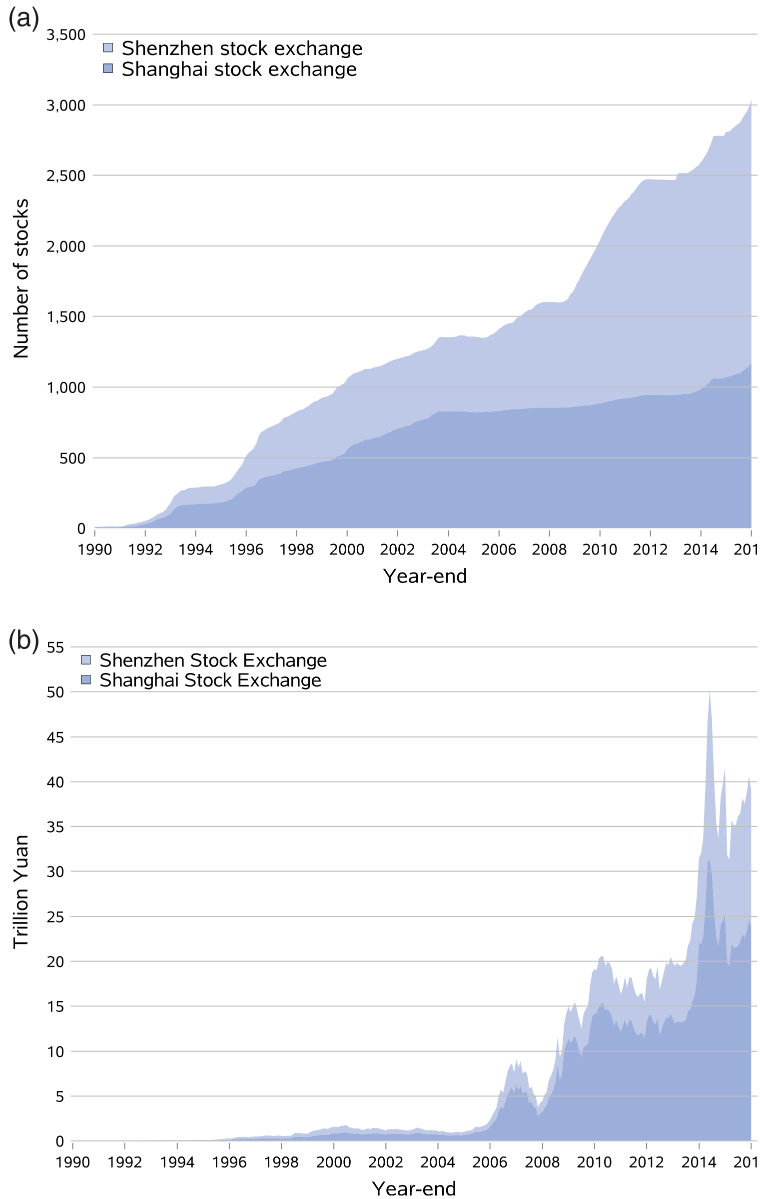

Figure 1 Growth of the Shanghai and Shenzhen Stock Exchanges from 1990 to 2016. [Color figure can be viewed at wileyonlinelibrary.com]

the Hong Kong Stock Exchange. Several empirical studies, such as Chan et al. (2008) and Mei et al. (2009), have shown that there are often substantial price discrepancies between B/H shares and their A-share counterparts issued by the same company.

Even for just A-shares, many listed Chinese firms have two types of shares, "floating" and "nonfloating" shares, which are often referred as the "split-share structure." Floating shares are shares issued to the public; they are listed and traded on exchanges and can be invested by domestic individuals and institutions. They are regarded as different from the preexisting "nonfloating" shares that often belong to different parts of the government. The latter are often traded via negotiations between various government and semi-government entities and later other legal entities, typically at book value. Through various reforms aimed at reducing state ownership in most state-owned enterprises and shifting them toward a more market-driven environment, nonfloating shares are gradually converted into floating shares. By the end of 2016, the proportion of the market capitalization of nonfloating shares dropped to approximately 23% from the peak of near 90% in early 1990. In this paper, we will mainly focus on the floating A shares, which represents what domestic investors can trade publicly in China's stock market.

The SSE and SZSE have a similar trading mechanism, in which orders are executed through a centralized electronic limit order book, based on the principle of price and time priority. Both exchanges impose daily price limits on traded stocks. The policy on price limits has gone through several stages. When the two exchanges were established in 1990, there were very strict rules on transaction prices and volumes. In the first few years, trading was quite thin on both exchanges. To encourage trading and improve market liquidity, the regulators withdrew price limits and adopted a free trading policy on May 12, 1992. Four years later on December 16, 1996, the government re-introduced the price limits policy amid concerns over speculation, an overheated market and social stability. The price limits were set at ±10% of the previous closing price, and has remained unchanged.

Unlike many open international stock markets, there are strict regulations on who can invest directly in China's domestic stock market. Major investors can be classified into four major classes: domestic individuals, domestic institutions, financial intermediaries and financial service providers (including brokers, integrated securities companies, investment banks, and trust companies), and qualified foreign institutional investors (QFII). It is worth emphasizing that commercial banks in mainland China are forbidden by law from participating in security underwriting or investing business, except for QFIIs. Commercial banks are also forbidden from lending funds to their clients for security business. Insurance companies are permitted to invest in common stocks only indirectly, through asset management products operated by mutual funds.

III. DATA

The data for our study are from the Chinese Capital Market (CCM) Database provided by the China Academy of Financial Research (CAFR). The CCM database covers basic accounting data and historical A-share returns for all Chinese stocks listed on the SSE and SZSE from 1990 to 2016.[6]

Although the Chinese stock market began in 1990, our main results are based on a sample from 1995 to 2016. The main consideration for this choice is that the number of stocks available in the early period was too limited to conduct any meaningful cross-section tests. There were very few stocks traded on the SSE and SZSE in their early days—eight stocks were listed in Shanghai in 1990 and six were listed in Shenzhen in 1991. It was not until 1995 when the number of stocks listed on the two exchanges first crossed the 300 benchmark. The majority of the literature on the Chinese stock market also use the sample period starting from 1995.

We match the accounting data for all Chinese firms in calendar year t–1 (1994–2015) with the returns from July of year t to June of t+1. The accounting data is extracted from annual reports filed by companies listed on the SSE and SZSE. Because all public Chinese firms end their fiscal year in December and are required by law to submit their annual reports no later than the end of April, the 6-month lag between accounting data and returns ensures that accounting variables are publicly available and the embedded information has been properly reflected in market prices. This match is also consistent with the standard approaches used in the literature for the US market.

Our main accounting variables are size and book-to-market ratio. A firm's size is measured as the floating A-share market capitalization at the end of June each year. We use only floating A shares to compute the size of a listed company for two reasons. First, only floating A shares are investable for general domestic investors, while nonfloating shares or other types of floating shares such as B and H shares are not. Second, nonfloating shares are not actively traded and their transaction prices are not determined in the open market but through private negotiations. Floating A-shares are the only share class that can be invested by a general domestic investor and have market prices. Thus, their market value provides a proper measure of the equity size for a listed company. There are, of course, other ways to construct the size variable. In the robustness check section, we confirm that our main results are robust to different size measures.

Following the same spirit, we calculate the B/M ratio as the fraction of book value of equity per share and floating A-share prices at the end of December in the previous year t–1. The numerator is the total book value divided by the total number of shares, which include A-, B-, and H-share classes and both floating and nonfloating shares. This adjustment ensures that the numerator for the B/M ratio calculation represents the book value per share. Other accounting variables include A/ME, A/BE, E(+)/P, and D/P ratios. A/ME is market leverage, measured as asset per share divided by floating A-share price at the end of December of year t–1; A/BE is book leverage, measured as asset per share

6 For details on the CCM database, readers can refer to Wang et al. (2014) and the data manual published by CAFR.

divided by book value of equity per share. E(+)/P is total positive earnings divided by price; E/P dummy is a dummy variable which takes zero if earning is positive and one otherwise. The price P in the denominators for the above ratios is the floating A-share price at the end of December in the previous year $t - 1$. D/P is the ratio between all dividends distributed in the 1-year horizon before the end of June and the floating A-share price at the end of June.

IV. CROSS-SECTIONAL RETURNS IN CHINA'S STOCK MARKET

A. Average returns

In most empirical asset pricing literature, researchers use the simple time-series averages of a stock's returns to estimate its expected premiums, in which the returns at every time during the sample period contribute equally to the simple averages. This simple time-series average, however, is less suitable as an estimator for the expected returns in the Chinese stock market due to the market's unique features.

The most important reason why the simple averages are unfitting for the Chinese market is due to the market's short history. In our paper, we use the sample period from 1995 to 2016, the longest among the existing literature. Yet, the total sample period still contains only 258 months, much shorter than the history for other more mature markets. Making the situation more challenging, the Chinese stock market has also experienced substantial changes through the years. This can be seen from the very unbalanced number of listed stocks on the SSE and SZSE exchanges. The two exchanges had 311 number of listed firms at the end of 1995, which is only around 10% of the total number of listed firms at the end of 2016. This is in sharp contrast to other more mature markets in which the total number of listed firms is usually much more stable across time.[7]

The fast-changing market condition is also reflected in the movement of the market volatilities through time. Figure 2 shows the monthly volatility of the Chinese market portfolio, estimated using the daily excess return of the market portfolio, $R_M - R_f$, during a rolling 3-month window. We construct the market portfolio as a monthly rebalanced value-weighted portfolio of all stocks on the SSE and SZSE, with weights being the stocks' floating A-share market capitalization. Clearly, the market volatility varies considerably across time—bouncing within a wide range of approximately 10% to 60% from 1995 to 2016. The average of the annualized market volatility is 27% and the standard deviation of the annualized market volatility is 12%. The market volatility peaks at around 60%, and reaches this peak during three periods: 1996–1997, 2008–2009, and the second half of 2015.

7 For example, the total number of listed firms in the NYSE, AMEX and NASDAQ, excluding investment funds and trusts, ranges between 3500 and 7500 from 1975 to 2016. Source: The World Federation of Exchanges.

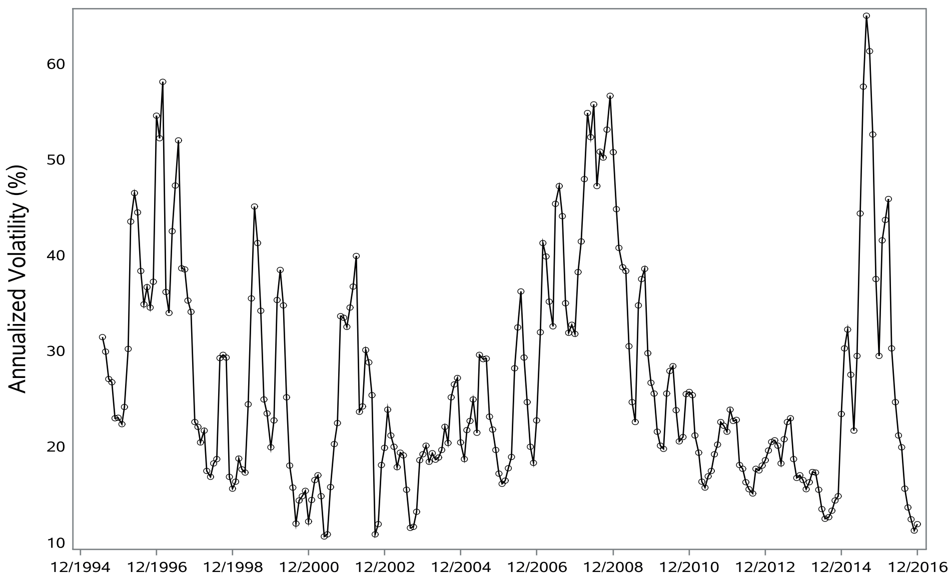

Figure 2 Volatility of the excess returns on the market portfolio $R_M - R_f$.

To take into account the fast-changing market conditions in the Chinese stock market, we model the monthly return of a portfolio at month t as an independent random draw x_t from a normal distribution with mean μ and known variance σ_t^2. In other words, the observed monthly returns share the same mean μ but have different variance σ_t^2 across time from $t = 1, \ldots, N$. We then use the inverse-variance weighted averages to estimate the portfolio's expected return μ:

$$\overline{X} = \frac{\sum_{t=1}^{N} \frac{1}{\sigma_t^2} \times x_t}{\sum_{t=1}^{N} \frac{1}{\sigma_t^2}}.$$

Under our model assumptions, $\overline{X}$ is unbiased and is the Maximum Likelihood Estimator (MLE) of the portfolio's expected return μ.[8] Intuitively, the inverse-variance weighted averages assign more weights to returns at months with low variance (high precision) and assign less weights to returns at months with high variance (low precision). The inverse-variance weighted averages have the property that it has the least variance among all weighted averages. In the special case when the variance $\{\sigma_t^2\}$ are the same across time, the

8 Though less common in the finance literature, the inverse-variance weighted averages are widely used in meta-analysis on applications such as clinical trials and psychological experiments. Hartung et al. (2008), Hunter and Schmidt (2004), and Hedges and Vevea (1998) provide detailed technical discussions on the statistical properties of the inverse-variance weighted averages.

inverse-variance weighted averages will reduce to the simple averages $\frac{1}{N}\sum_{t=1}^{N} x_t$. The variance of $\overline{X}$ is:

$$\sigma^2\left(\overline{X}\right) = \frac{1}{\sum_{t=1}^{N} \frac{1}{\sigma_t^2}}.$$

In practice, we do not directly observe the variance of the return σ_t^2 at each month t. We estimate it by $\hat{\sigma}_t^2$ using the historical returns that can be observed empirically. For the main results in this paper, we calculate $\hat{\sigma}_t^2$ as the annualized variance of the daily returns on the portfolio during a rolling 3-month window from the beginning of month t–2 to the end of month t. In the robustness check, we report the results based on variances estimated using other ways. We construct our variance adjusted estimator for the expected return μ as the following:

$$\hat{X} = \frac{\sum_{t=1}^{N} \frac{1^2}{\hat{\sigma}t} \times x_t}{\sum_{t=1}^{N} \frac{1^2}{\hat{\sigma}t}}.$$

The variance of $\hat{X}$ can be expressed as:

$$\sigma^2\left(\hat{X}\right) = \frac{1}{\sum_{t=1}^{N} \frac{1^2}{\hat{\sigma}t}} \times \frac{1}{(N-1)} \sum_{t=1}^{N} \frac{\left(x_t - \hat{X}\right)}{\hat{\sigma}_t^2}$$

where the second term is a reduced chi-squared term which accounts for the errors in the variance estimator $\hat{\sigma}_t^2$ at each month t.[9]

B. Univariate sorted portfolios

To investigate the potential size and value effect in cross-sectional returns of Chinese-listed firms, we first look at performances of 10 size- and B/M-sorted portfolios. At the end of June of each year from 1995 to 2016, we divide all nonfinancial firms listed on the SSE and SZSE into 10 equally populated groups on the basis of their size or B/M ratios. The portfolios are kept unchanged for the following 12 months, from July to June next year. Returns for the 10 portfolios are calculated as the equal-weighted average of individual stock returns.

Table 1 reports the average excess returns and firm characteristics of the 10 univariate sorted portfolios, Panel A for the size-sorted portfolios and Panel B for the B/M-sorted portfolios. For both Panel A and Panel B, the average returns are the inverse-variance weighted average returns of the 10 size- and

9 We assume that the errors in the variance estimator $\{\hat{\sigma}_t^2\}$ are uncorrelated with those in the observed returns $\{x_t\}$.

Table 1 Characteristics of portfolios formed on size and book-to-market ratios

Panel A: Portfolio formed on size

Variables	Small	2	3	4	5	6	7	8	9	Large	Large-Small
Return	1.84***	1.68***	1.33**	1.33**	0.97*	0.89*	0.54	0.49	0.45	0.10	−1.23***
	(3.11)	(2.97)	(2.49)	(2.53)	(1.91)	(1.76)	(1.12)	(1.05)	(0.96)	(0.22)	(−3.33)
ME(in million)	677	994	1215	1462	1736	2130	2640	3477	5251	19,013	18,336
B/M ratio	0.31	0.36	0.37	0.4	0.42	0.42	0.41	0.42	0.42	0.43	0.12
% of market value	2.19	3.19	3.88	4.65	5.47	6.64	7.94	10.22	14.58	41.23	39.04
A/ME	0.63	0.71	0.77	0.83	0.9	0.88	0.88	0.88	0.92	0.94	0.31
A/BE	3.04	2.33	2.19	2.21	2.33	2.26	2.15	2.13	2.14	2.11	−0.93
E/P ratio(%)	1.54	1.95	2.13	2.25	2.45	2.85	2.87	3.35	3.76	4.69	3.15
E/P dummy	0.17	0.11	0.11	0.09	0.10	0.07	0.06	0.05	0.03	0.02	−0.15
D/P ratio(%)	0.36	0.42	0.49	0.50	0.60	0.65	0.72	0.76	0.90	1.00	0.65
Floating ratio	0.35	0.45	0.50	0.53	0.55	0.56	0.56	0.58	0.58	0.60	0.24
β^M	1.04	1.06	1.08	1.09	1.08	1.06	1.04	1.03	1.05	1.00	−0.03
N	114	114	115	114	115	115	115	116	115	115	

Panel B: Portfolio formed on B/M ratio

Variables	Low	2	3	4	5	6	7	8	9	High	High-Low
Return	0.29	0.65	0.66	0.92*	0.97*	1.09**	1.22**	1.14**	1.17**	1.23**	0.38
	(0.58)	(1.33)	(1.34)	(1.86)	(1.93)	(2.13)	(2.42)	(2.21)	(2.26)	(2.50)	(1.51)
ME(in million)	4091	3394	2993	3000	2949	3137	3302	4374	4427	7108	3017
B/M ratio	0.13	0.20	0.25	0.30	0.34	0.39	0.44	0.50	0.59	0.81	0.68
% of market value	10.16	9.33	8.65	8.41	8.50	8.70	9.07	10.71	11.33	15.15	4.99
A/ME	0.36	0.44	0.52	0.59	0.67	0.78	0.89	1.03	1.24	1.82	1.46

Table 1 (*continued*)

Panel B: Portfolio formed on B/M ratio

Variables	Low	2	3	4	5	6	7	8	9	High	High-Low
A/BE	4.60	2.15	2.04	1.94	1.95	1.98	1.98	2.02	2.07	2.18	−2.42
E/P ratio (%)	1.62	2.14	2.36	2.47	2.76	2.9	3.08	3.28	3.47	3.78	2.16
E/P dummy	0.18	0.09	0.07	0.06	0.06	0.06	0.07	0.06	0.08	0.09	−0.09
D/P ratio (%)	0.22	0.37	0.49	0.54	0.63	0.71	0.78	0.75	0.89	1.02	0.80
Floating ratio	0.49	0.49	0.50	0.50	0.52	0.52	0.53	0.55	0.57	0.59	0.10
β^M	1.00	0.98	1.01	1.01	1.08	1.06	1.08	1.11	1.11	1.10	0.10
N	114	114	115	115	115	115	115	115	115	115	

Ten portfolios are formed every year at the end of June from 1995 to 2016, on the basis of underlying stocks' size or book-to-market ratios. Returns are the weighted time-series averages of the monthly portfolio returns, reported in percent, for the period from September 1995 to December 2016. The weights are the inverse of the variance, estimated using the portfolio's daily returns in a 3-month rolling window. The *t*-values for the variance-adjusted returns are reported in square brackets. ME (in millions) is the floating market capital measured in millions of Chinese renminbi (RMB). B/M ratio is the ratio of book value of equity per share and floating A-share price. % of market value is the fraction of a portfolio's total ME out of the total market's ME. A/ME is asset per share divided by stock price. A/BE is asset per share divided by book value of equity per share. E(+)/P is total positive earnings divided by price. E/P dummy takes one if earnings is negative and zero otherwise. D/P is total cash dividends, scaled by price. The price P in the above denominators is the floating A-share price at the end of December each year from 1994 to 2015. Floating ratio is the fraction of floating A shares out of a firm's total outstanding shares. β^M is the slope on the market excess returns, $R_M - R_f$, in a full-sample CAPM regression. N is the average number of stocks within each portfolio. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

B/M-sorted portfolios, where the variance is estimated using the portfolios' daily returns in a 3-month rolling window. When portfolios are formed on size, we observe a strong negative relationship between size and average returns. Though not strictly monotonic, there is a general decreasing trend in the average returns as portfolio size increases from the smallest to the largest portfolio. Average variance-adjusted returns fall from 1.84% per month for the smallest size portfolio to 0.10% per month for the largest size portfolio. A long-short portfolio which longs the smallest portfolio and shorts the largest size portfolio earns an average variance-adjusted return of −1.23% per month, which is statistically significant at the 1% level.

We also report full sample CAPM market beta β^Ms for the 10 size-sorted portfolios, which are the slope coefficients in the regressions of monthly excess returns on the excess returns of a market portfolio over the 258 months from July 1995 to December 2016. It is worth emphasizing that there is no correlation between a firm's size and its market β^M in the Chinese market. The market β^Ms for the 10 size-sorted portfolios are close in magnitudes. The market β^M for the largest size portfolio is 1.00, very close to the market β^M (1.04) for the smallest size portfolio. This observation differs from the strong negative correlation between size and market β^Ms in the US market, where smaller US firms tend to have larger market β^Ms. Given that the market β^Ms are flat across different size portfolios in the Chinese market, variations in average returns are likely to be driven by the portfolios' differences in size, not by their exposures to market risk.

On average, there are 114–115 firms in each portfolio during the sample period. Average floating A-share market capitalization (ME) for stocks in the smallest size group is 677 million RMB, representing only 2.19% of total market capitalization. By contrast, stocks in the largest size group have ME close to 19 billion RMB, or 41% of the total market capitalization. Smaller firms tend to have lower earnings to price and lower dividend ratios. There is no strong correlation between a firm's size and its book-to-market ratios. For example, the average book-to-market ratios for the 5th to the 10th size deciles are all between 0.42 and 0.43.

In contrast to the strong negative relation between size and average returns, we observe no pattern in the average returns of portfolios sorted on B/M ratios. Average variance-adjusted returns range from 0.29% per month to 1.23% per month. A long-short portfolio which longs the portfolio with the highest B/M ratios and shorts the portfolio with the lowest B/M ratios earns an average variance-adjusted return of 0.38% per month, which has a *t*-value of 1.51 and is insignificant from zero. In fact, the portfolio with the highest average variance-adjusted return is the 10th book-to-market deciles and all portfolios from the 4th deciles to the l0th deciles have similar levels of returns, ranging from 0.92% to 1.23%. In other words, large spreads in B/M ratios do not generate large variations in portfolio returns, an indication that the value effect is not strong in the Chinese stock market. In terms of other firm characteristics, low B/M ratio firms are generally the ones with low market leverage and high book leverages. They also have low earnings-to-price and dividend ratios.

C. Construction of the size and value factor

To mimic underlying risk factors related to size and book-to-market ratios, we first construct six portfolios by intersecting two size-sorted portfolios with three B/M-sorted portfolios. At June of each year *t*, we form two size portfolios, Small and Big, by dividing all nonfinancial stocks listed on the SSE and SZSE equally into two groups on the basis of their floating A-share market capitalization. Similarly, three B/M portfolios are formed by assigning all stocks into three groups by their book-to-market ratios: Low, Medium, and High. The three subgroups represent the bottom 30%, middle 40%, and top 30%, respectively. The two size-sorted portfolios and three B/M-sorted portfolios produce six portfolios: Small-Low, Small-Medium, Small-High, Big-Low, Big-Medium, and Big-High. For example, the Small-Low portfolio contains the stocks in the Small size group that are also in the Low book-to-market group. Monthly value-weighted returns on the six portfolios are calculated from July of year *t* to June of *t*+1, where the weight for each stock is its floating A-share market capitalization. The portfolios are reformed in June of *t*+1.[10]

We then construct two portfolios, SMB and HML, which mimic risk factors in returns related to size and book-to-market ratios. SMB (small minus big) is the difference between the simple average of the returns on the three small-stock portfolios (Small-Low, Small-Medium, and Small-High) and the three big-stock portfolios (Big-Low, Big-Medium, and Big-High). Since the two components of SMB are returns on small- and big-stock portfolios with about the same weighted-average book-to-market ratios, SMB captures the different return behaviors of small and big stocks and is largely free of the influence related to book-to-market ratios. Similarly, we construct a HML portfolio, which is the difference between the simple average of the returns on the two high B/M portfolios (Small-High and Big-High) and the two low B/M portfolios (Small-Low and Big-Low).

Table 2 summarizes the returns of the market factor, SMB and HML, as well as the six size- and BM-sorted portfolios. Similar as before, we report the variance adjusted average returns, which are the average returns weighted by the inverse of the variance at each month *t*. The variance is estimated using the portfolio's daily return in a 3-month rolling window. Over the sample period, SMB earns an average variance adjusted return of 0.61% per month, or 7.32% per year. The average return of SMB is not only economically large but also

10 We follow the existing literature to sort firms into three groups on B/M ratios and only two on size. The main consideration for the split is to be consistent with the classic Fama–French factors for the US market. Given that the size effect is actually stronger in the Chinese market, we also consider two different splits in the robustness check section. The results remain similar.

Table 2 Average returns of $R_M - R_f$, SMB, HML, and the six size-B/M sorted portfolios

Panel A: China's A share market, September 1995 to December 2016									
	$R_M - R_f$	SMB	HML	Small-Low	Small-Medium	Small-High	Big-Low	Big-Medium	Big-High
Mean	0.52	0.61***	0.23	0.98*	1.39***	1.43***	–0.44	0.35	0.65
T	(1.22)	(2.89)	(1.40)	(1.89)	(2.65)	(2.63)	(–1.03)	(0.78)	(1.48)
Panel B: US market, September 1995 to December 2016									
	$R_M - R_f$	SMB	HML	Small-Low	Small-Medium	Small-High	Big-Low	Big-Medium	Big-High
Mean	1.04***	0.07	0.17	1.07***	1.32***	1.48***	0.99***	1.06***	1.19***
T	(4.99)	(0.42)	(1.32)	(2.97)	(4.91)	(5.64)	(4.83)	(5.20)	(5.06)
Panel C:US market, July 1962 to December 2016									
	$R_M - R_f$	SMB	HML	Small-Low	Small-Medium	Small-High	Big-Low	Big-Medium	Big-High
Mean	0.76***	0.23**	0.25***	0.96***	1.26***	1.33***	0.69***	0.70***	0.94***
T	(5.83)	(2.34)	(3.14)	(4.80)	(8.04)	(8.42)	(5.14)	(5.49)	(6.32)

The summary statistics of the returns on the market $R_M - R_f$, SMB, HML, and the six size-B/M sorted portfolios are reported, separately for the Chinese and the US stock markets. Returns are the weighted time-series averages of the monthly portfolio returns, reported in percent, for the period from September 1995 to December 2016. The weights are the inverse of the variance, estimated using the portfolio's daily returns in a 3-month rolling window. The t-values for the variance-adjusted returns are reported in square brackets. For the Chinese market, $R_M - R_f$ is the excess return on a value weighted market portfolio, in which the weights are stocks' floating A-share market capital. At June of each year t, six size-B/M double sorted portfolios are formed by intersecting two size portfolios (Small and Big) and three value portfolios (Low, Medium, and High). The summary statistics are calculated based on the excess returns on the six portfolios: Small-Low, Small-Medium, Small-High, Big-Low, Big-Medium, and Big-High. SMB (small minus ig) is the difference between the simple averages of the returns on the three small-stock portfolios (Small-Low, Small-Medium, and Small-High) and the three big-stock portfolios (Big-Low, Big-Medium, and Big-High). HML (high minus low) is the difference between the simple averages of the returns on the two high-B/M portfolios (Small-High and Big-High) and the two low-B/M portfolios (Small-Low and Big-Low). The market factor $R_M - R_f$, SMB, HML, and the six size-B/M sorted portfolios for the US market are obtained from the Fama and French website. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

strongly positive significant with *t*-value 2.89. By comparison, the average variance adjusted return of $R_M - R_f$ is 0.52% per month with a *t*-value of 1.22; the average variance adjusted return of HML is 0.23% per month with a *t*-value of 1.40. Neither the market $R_M - R_f$ nor HML has statistically significant average returns.

To draw a parallel between the factors of the Chinese market and those of the US market, we put the summary statistics of the three factors we constructed for the Chinese market along with those in the US market. Since one concern of our study is that our sample period covers only 256 months from September 1995 to December 2016, we report summary statistics for the three factors in the US market separately for two sample periods: one is the same sample period from September 1995 to December 2016 and another one is a much longer period since 1962 (July 1962–December 2016).[11] For the factors of the US market, the average excess returns from July 1962 to December 2016 is 0.76% per month for the market portfolio; 0.23% per month for SMB; 0.25% per month for HML. Consistent with the existing literature, we find that the market, and SMB and HML factors all have significant positive average returns. In contrast, for the shorter period from September 1995 to December 2016, only the US market factor have statistically significant average returns while SMB and HML do not have statistically significant average returns. The lack of statistical significance of the US SMB and HML factors during the shorter period underscores the difficulties of performing cross-sectional pricing tests on samples with small size. Though we have designed various methods to mitigate the potential small-sample biases in our study, we acknowledge that our results are unavoidably limited by the short history of the Chinese stock market.

Table 3 reports the correlation structure of the three Chinese return factors and the three US market return factors. Among the three Chinese factors, the market and SMB have significant positive correlation of 0.16; the market and the HML factor also have a significant positive correlation of 0.21. SMB and HML are not correlated with each other. On the contrary, the three factors in the US market are all strongly correlated with one another. For the same time period from 1995 to 2016, the correlation is 0.23 for the market factor and SMB; –0.15 for the market factor and HML; –0.29 for SMB and HML. The correlations are all statistically significant at the 1% or 5%level. The three US factors exhibit similar correlations over the longer period from 1962 to 2016. There is no strong cross-correlation between the Chinese and US market factors, with the exception that the Chinese market tends to move in the same direction with the US market, with a positive correlation of 0.19.

11 Our factors are constructed for the period from July 1995 to December 2016. However, since the variance of the factors are estimated using a 3-month rolling window, the variance-adjusted returns cover only 256 months from September 1995 to December 2016.

Table 3 Correlations of $R_M - R_f$, SMB, and HML factors

Panel A: China's A share market (July 1995 to December 2016)	$R_M - R_f^{CH}$	SMB^{CH}	HML^{CH}	Panel B: US market (July 1995 to December 2016)	$R_M - R_f^{US}$	SMB^{US}	HML^{US}
$R_M - R_f^{CH}$		0.16***	0.21***	$R_M - R_f^{US}$		0.23***	–0.15**
SMB^{CH}			–0.03	SMB^{US}			–0.29***
Panel C: US market (July 1962 to December 2016)	$R_M - R_f^{US}$	SMB^{US}	HML^{US}	**Panel D: China's A share market and US market (July 1995 to December 2016)**	$R_M - R_f^{US}$	SMB^{US}	HML^{US}
$R_M - R_f^{US}$		0.30***	–0.26***	$R_M - R_f^{CH}$	0.19***	0.04	–0.02
SMB^{US}			–0.20***	SMB^{CH}	–0.02	–0.11*	0.03
				HML^{CH}	–0.04	–0.07	0.15**

Panel A reports the pairwise correlations of monthly returns on $R_M - R_f$, SMB, and HML in the China's stock market from July 1995 to December 2016; Panel B reports the pairwise correlations of monthly returns on $R_M - R_f$, SMB, and HML in the US stock market from July 1995 to December 2016; Panel C reports the pairwise correlations of monthly returns on $R_M - R_f$, SMB, and HML in the US stock market from July 1962 to December 2016; Panel D reports the pairwise correlations of monthly returns on $R_M - R_f$, SMB, and HML in the China's stock market and those in the US stock market from July 1995 to December 2016. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

V. ASSET-PRICING TESTS

A. Time-series regressions

For a formal asset-pricing test, we first employ the time-series regression approach of Jensen et al. (1972) and Fama and French (1993). Monthly excess returns of stocks are regressed on the excess returns to a market portfolio of stocks ($R_M - R_f$) and mimicking portfolios for size (SMB) and book-to-market ratio (HML). If assets are priced rationally, the slopes and R^2 in the time-series regressions should reflect whether mimicking portfolios for the risk factors related to size and B/M captures common variations in stock returns not explained by the market factor. Moreover, the estimated intercepts in such regressions provide direct evidence on how well the combined factors explain the cross-section of average returns.

We follow the literature to form 25 double-sorted portfolios. In June of each year *t*, we sort, independently, all nonfinancial stocks listed on the SSE and SZSE to five size and book-to-market quintiles. We then form the 25 portfolios from the intersections of the size and B/M quintiles. The portfolios are kept unchanged for the next 12 months, from July of year *t* to June of year *t* + 1. We calculate monthly portfolio returns as the value-weighted average of individual stocks in each portfolio, in which the weights are the floating A-share market capitalization.

Table 4 summarizes the characteristics of the companies in the 25 double-sorted portfolios. The double sorting produces a wide spread in size and B/M ratios. Across the 25 portfolios, average size ranges from 811 million RMB to 16.1 billion RMB and average B/M ratio range from 0.16 to 0.75. The average number of firms in each portfolio varies from 20 for the smallest-size and highest-B/M ratio portfolio to 60 for the largest-size and highest-B/M ratio portfolio. Controlling for size, high B/M portfolios tend to have high dividend yields and high earnings to price ratios. These are generally in line with patterns in the US market. In addition, average floating ratios increase from the small- to large-size portfolios in each of the B/M quintiles, with the differences ranging from 0.14% to 0.22%. Average floating ratios also tend to rise as B/M ratio increases, though the magnitudes are smaller. In other words, large and value firms also tend to be those with higher percentage of floating share.

Table 4 also reports the average variance-adjusted excess returns of the 25 size-B/M sorted portfolios, where the variances are estimated using the portfolios' daily excess returns during a rolling 3-month window. There is a large dispersion in average excess returns across the 25 portfolios, from –0.58% to 1.94% per month. Consistent with the patterns for the univariate sorted portfolios, average returns and size show a clear negative relation. In each of the B/M quintiles, excess returns monotonically decrease from the smaller- to the larger-size portfolios. By comparison, the relation between average returns and book-to-market equity is much weaker. Though average returns show a tendency to rise as B/M ratios increase, the pattern is not monotonic and often very flat. It is worth emphasizing that large-size stocks do not have significant positive excess returns in the Chinese market during the sample period. Only one of the portfolios in the top three size quintiles has excess return that is significant at the 5% level. For the remaining 10 portfolios in the bottom two size quintiles, nine portfolios have excess returns that are significant at the 5% level.

For each of the 25 size-B/M sorted portfolios, we run the following regression:

$$R_{pt} - R_{ft} = \alpha_p + \beta_p^M \left(R_{Mt} - R_{ft}\right) + \beta_p^{\mathrm{SMB}} \mathrm{SMB}_t + \beta_p^{\mathrm{HML}} \mathrm{HML}_t + \epsilon_{pt} \tag{1}$$

where $R_{pt} - R_{ft}$ is the excess return on the portfolio at month t, $R_{Mt} - R_{ft}$ is the excess return of the value-weighted Chinese market index, SMB_t and HML_t are returns on two zero-cost factor-mimicking portfolios for size and book-to-market, respectively.

We report the time-series regression results in Table 5. Slopes on the market excess returns, β^Ms, are all strongly statistically significant. Unlike the US market, β^Ms across the 25 portfolios are much flatter, with variation less than 0.15.

Table 4 Summary statistics of the 25 portfolios formed on size and book-to-market ratios

Size quintile	B/M quintile											
	Low	2	3	4	High	High-Low	Low	2	3	4	High	High-Low
	Excess return (%)											
Small	1.66***	1.39**	1.69***	1.73***	1.94***	0.31						
	(2.94)	(2.47)	(2.97)	(2.87)	(3.15)	(1.34)						
2	0.61	1.20**	1.29**	1.49***	1.60***	0.42**						
	(1.17)	(2.32)	(2.38)	(2.74)	(2.89)	(2.06)						
3	0.17	0.81	0.91*	1.00*	1.14**	0.31						
	(0.36)	(1.60)	(1.81)	(1.96)	(2.17)	(1.50)						
4	–0.28	0.08	0.45	0.7	0.90*	0.31						
	(–0.62)	(0.18)	(0.92)	(1.46)	(1.79)	(1.24)						
Big	–0.58	–0.28	0.09	0.42	0.46	0.26						
	(–1.37)	(–0.66)	(0.20)	(0.92)	(1.08)	(0.88)						
Big-Small	–1.50***	–1.25***	–1.12***	–0.82**	–1.04**	0.40						
	(–4.19)	(–3.75)	(–3.42)	(–2.19)	(–2.56)	(1.25)						
	ME (in millions)						B/M ratio					
Small	811	814	842	876	926	115***	0.16	0.28	0.36	0.47	0.63	0.47***
2	1323	1300	1352	1344	1369	46***	0.17	0.28	0.37	0.47	0.66	0.49***
3	1938	1939	1938	1916	1927	–11	0.17	0.28	0.37	0.47	0.69	0.52***
4	3044	3011	2971	3135	3101	57	0.17	0.28	0.37	0.47	0.70	0.53***
Big	10,340	9062	9384	13,254	16,134	5795***	0.17	0.27	0.36	0.47	0.75	0.58***
Big-Small	9529***	8247***	8542***	12378***	15208***	.	0.01***	–0.00**	0	0.00***	0.12***	.
	N						Floating ratio					
Small	53	56	54	45	20	–33***	0.40	0.38	0.40	0.42	0.47	0.06***
2	44	46	50	48	41	–3***	0.47	0.48	0.51	0.54	0.56	0.09***

Table 4 (*continued*)

Size quintile	B/M quintile											
	Low	2	3	4	High	High-Low	Low	2	3	4	High	High-Low
3	37	43	46	50	54	17***	0.51	0.53	0.55	0.57	0.59	0.08***
4	43	43	42	46	55	12***	0.52	0.56	0.58	0.59	0.61	0.09***
Big	51	41	38	40	60	9***	0.57	0.60	0.58	0.60	0.60	0.03***
Big-Small	−2	−15***	−15***	−5***	40***	.	0.17***	0.22***	0.18***	0.18***	0.14***	.
	E/P ratio						D/P ratio					
Small	1.22	1.8	1.98	1.99	2.06	0.84***	0.14	0.39	0.51	0.54	0.51	0.38***
2	1.73	1.93	2.33	2.54	2.42	0.70***	0.25	0.40	0.53	0.61	0.66	0.41***
3	1.78	2.42	2.81	3.08	2.95	1.17***	0.26	0.54	0.63	0.71	0.85	0.59***
4	2.21	2.57	3.30	3.43	3.82	1.60***	0.41	0.56	0.78	0.91	0.94	0.53***
Big	2.67	3.65	3.98	4.99	5.35	2.68***	0.44	0.73	0.96	1.10	1.37	0.93***
Big-Small	1.45***	1.84***	2.01***	2.99***	3.29***	.	0.30***	0.35***	0.46***	0.56***	0.85***	.

Characteristics of 25 size-B/M portfolios are reported. The 25 portfolios are formed at the end of each June from 1995 to 2016, by intersecting five size-sorted portfolios and five B/M sorted portfolios. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively. Excess returns are the weighted time-series averages of the portfolios' excess returns, reported in percent, for the period from September 1995 to December 2016. The weights are the inverse of the variance, estimated using the portfolio's daily excess returns in a 3-month rolling window. The *t*-values for the variance-adjusted excess returns are reported in square brackets. ME (in millions) is the floating market capital measured in millions of Chinese renminbi (RMB). B/M ratio is the ratio of book value of equity per share and floating A-share price. *N* is the average number of stocks within each portfolio. Floating ratio is the fraction of floating A shares out of a firm's total outstanding shares. E(+)/P is total positive earnings divided by price. The price P in the above denominators is the floating A-share price at the end of December each year from 1994 to 2015. D/P is total cash dividends, scaled by price at the end of June. *, **, and *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Table 5 Time-series regressions of the excess returns of 25 size-B/M sorted portfolios on $R_M - R_f$, SMB, and HML

Size Quintile	B/M quintile									
	Low	2	3	4	High	Low	2	3	4	High
	Abnormal return: α_p									
Small	0.23	0.16	0.46**	0.05	−0.04					
	(1.40)	(1.47)	(2.55)	(0.22)	(−0.20)					
2	−0.19	0.10	0.13	0.25	−0.13					
	(−1.62)	(0.66)	(0.76)	(1.46)	(−0.70)					
3	−0.35**	0.13	0.03	−0.31*	−0.36**					
	(−2.53)	(0.76)	(0.15)	(−1.77)	(−2.32)					
4	−0.29	−0.26	−0.13	−0.21	−0.34**					
	(−1.63)	(−1.52)	(−0.56)	(−1.07)	(−2.16)					
Big	0.12	−0.32	0.18	0.16	0.11					
	(0.68)	(−1.54)	(0.85)	(0.98)	(0.85)					
	$R_{M,\,t} - R_{f,\,t}$: β_p^M					Coefficients of SMB: β_p^{SMB}				
Small	0.94***	0.98***	1.00***	0.99***	0.99***	1.16***	1.21***	1.09***	1.41***	1.30***
	(28.60)	(38.53)	(42.60)	(32.22)	(34.38)	(12.93)	(26.28)	(16.57)	(11.87)	(13.15)
2	1.02***	0.98***	1.04***	1.04***	1.03***	0.82***	0.83***	1.03***	0.97***	1.09***
	(51.94)	(44.25)	(18.11)	(31.95)	(41.47)	(16.89)	(13.82)	(16.46)	(14.50)	(14.69)
3	0.95***	1.00***	1.02***	1.00***	1.01***	0.75***	0.68***	0.67***	0.81***	0.83***
	(36.65)	(45.40)	(42.68)	(43.10)	(32.18)	(18.97)	(10.70)	(11.67)	(11.18)	(12.54)

Table 5 (*continued*)

Size Quintile	B/M quintile									
	Low	2	3	4	High	Low	2	3	4	High
4	0.98***	1.02***	1.02***	1.01***	1.03***	0.45***	0.49***	0.41***	0.43***	0.48***
	(41.29)	(34.11)	(34.93)	(35.78)	(35.28)	(7.18)	(6.98)	(3.39)	(6.23)	(8.14)
Big	1.01***	1.00***	1.09***	1.03***	0.97***	−0.23***	−0.04	−0.24**	−0.21***	−0.36***
	(35.32)	(35.15)	(28.78)	(34.49)	(35.67)	(−3.50)	(−0.44)	(−2.23)	(−2.65)	(−7.56)
	Coefficients of HML: β_p^{HML}					R^2				
Small	−0.53***	−0.35***	−0.36***	0.33*	0.46***	92.1	95.5	95.0	92.1	90.7
	(−4.47)	(−8.23)	(−5.18)	(1.87)	(3.18)					
2	−0.66***	−0.55***	−0.04	0.08	0.40***	93.9	94.2	92.2	93.9	92.6
	(−9.98)	(−8.87)	(−0.54)	(1.36)	(5.41)					
3	−0.51***	−0.43***	−0.24***	0.17*	0.55***	93.2	91.2	93.1	92.9	94.5
	(−8.29)	(−5.02)	(−3.06)	(1.79)	(5.62)					
4	−0.66***	−0.51***	−0.21	0.08	0.50***	90.9	90.4	89.3	91.1	93.8
	(−11.12)	(−5.83)	(−1.58)	(1.20)	(6.52)					
Big	−0.82***	−0.2	−0.30***	0.16**	0.50***	92.8	88.4	88.0	92.1	94.6
	(−10.52)	(−1.63)	(−3.71)	(2.24)	(10.28)					

For each of the 25 size-B/M sorted portfolios, we run the regression: $R_{pt}-R_{ft}=\alpha_p+\beta_p^{M}\left(R_{Mt}-R_{ft}\right)+\beta_p^{SMB}SMB_t+\beta_p^{HML}HML_t+\epsilon_{pt}$, where $R_{pt}-R_{ft}$ is the excess return on the portfolio at month t, $R_{Mt}-R_{ft}$ is excess return on the market portfolio, SMB_t and HML_t are returns on two factor mimicking portfolios of size and book-to-market ratio, respectively. The sample period is from July 1995 to December 2016. The t-values are based on the Newey-West adjusted standard errors. *, **, and *** correspond to statistical significance at 10%, 5%, and 1%, respectively.

More important, β^Ms show no relation with size and B/M ratios. Thus, although the market factor can help to explain the overall magnitude of average excess returns of each portfolio, it cannot explain the wide variations related to size and B/M ratios. By contrast, slopes on SMB and HML are not only statically significant but also keep the orderings of the corresponding size and book-to-market ratios. The slopes on SMB are in general large and strongly significant. The significance of the slopes on HML, however, is much weaker than those of the slopes on the market factor and SMB. R-squared across the 25 portfolios are quite high, from 88.0% to 95.5%.

We then turn to the most important metrics, αs, which are the intercepts of the time-series regressions on the excess returns of the 25 size and B/M sorted portfolios. The results are encouraging—all of the αs are small in magnitude and 20 out of 25 αs are nonsignificant from zeros. More important, the remaining αs show no relation with neither size nor B/M ratios. Judging on the basis of the intercepts, the three factors, Market, SMB, and HML, successfully capture the cross-section of average returns. Moreover, given the flat structure of market β^Ms, the returns variations related to size and book-to-market ratios are more likely to be driven by exposures to the two factor mimicking portfolios, SMB, and HML.

To separate roles played by each of the three factors, we report intercepts for different model setups in Table 6. When the market excess returns are used alone to explain portfolio excess returns in the time-series regressions, the intercepts αs are strongly significant. In fact, 12 portfolios have positive significant αs and two portfolio has negative significant α. In addition, the remaining αs still maintain the cross-section pattern with size and B/M ratios. In contrast, using SMB as the sole factor makes all intercepts in the time-series regressions nonsignificant from zeros. More important, after taking out the exposures to the SMB factor, the remaining intercepts no longer monotonically decreases with respect to size. However, even though SMB makes all the αs statistically insignificant, all αs remain positive, and the highest α is at 1.27% per month. When combining SMB with the market factor, the intercepts are further reduced in magnitude and range from –0.72% per month to 0.43% per month. HML, on the other hand, is not very successful in explaining cross-section returns. Whether used alone or in combination with the market factor, the αs for portfolios in the bottom three size quintiles remain large and statistically significant. Putting all evidence together, it is clear that SMB is the most important factor in terms of explaining cross-section returns in China's stock market.

We also perform the Gibbons, Ross, and Shanken F-tests to formally test whether the intercepts for the 25 stock portfolios are jointly zero for different models. Table 7 reports the F-statistics and the associated probability levels. The model which includes all three factors, $R_M - R_f$, SMB, and HML, produces a F-statistic of 1.423 with a bootstrap probability of 0.786. Therefore, we cannot reject the hypothesis that the intercepts for the 25 portfolios are all zeros in a three-factor model. Among the three 2-factor models, we cannot reject the jointly-zero intercepts hypothesis for the two 2-factor models that involve the

Table 6 Intercepts from regressing the excess returns of the 25 portfolios formed on size and book-to-market ratios

Size Quintile	B/M quintile									
	Low	2	3	4	High	Low	2	3	4	High
	$R_t^p = \alpha_p + \beta_p^M (R_{M,t} - R_{f,t}) + \epsilon_t^p$					$R_t^p = \alpha_p + \beta_p^{SMB} SMB_t + \epsilon_t^p$				
Small	0.86**	0.94**	1.14***	1.40***	1.29***	0.6	0.7	1.01	1.1	1.11
	(2.13)	(2.53)	(3.33)	(3.91)	(3.66)	(0.84)	(0.97)	(1.38)	(1.43)	(1.34)
2	0.09	0.46	0.95***	1.09***	1.00***	0.15	0.5	0.96	1.16	1.01
	(0.27)	(1.48)	(3.29)	(3.86)	(3.28)	(0.20)	(0.71)	(1.22)	(1.41)	(1.19)
3	–0.03	0.44	0.43*	0.46**	0.65***	0.06	0.64	0.68	0.64	0.87
	(–0.11)	(1.58)	(1.70)	(2.18)	(2.96)	(0.08)	(0.86)	(0.93)	(0.84)	(1.08)
4	–0.32	–0.16	0.08	0.19	0.35*	0.03	0.19	0.55	0.67	0.86
	(–1.22)	(–0.67)	(0.41)	(1.03)	(1.79)	(0.04)	(0.26)	(0.71)	(0.83)	(1.04)
Big	–0.55**	–0.47***	–0.2	0.09	0.11	0.34	0.35	0.84	1.13	1.27
	(–2.02)	(–2.88)	(–1.15)	(0.48)	(0.53)	(0.44)	(0.50)	(1.02)	(1.39)	(1.57)
	$R_t^p = \alpha_p + \beta_p^{HML} HML_t + \epsilon_t^p$					$R_t^p = \alpha_p + \beta_p^M (R_{M,t} - R_{f,t}) + \beta_p^{SMB} SMB_t + \epsilon_t^p$				
Small	2.06***	2.07***	2.28***	2.15***	1.97**	–0.12	–0.06	0.22	0.26	0.26
	(2.77)	(2.68)	(3.12)	(2.66)	(2.39)	(–0.60)	(–0.49)	(1.39)	(1.46)	(1.37)
2	1.39*	1.67**	1.93***	1.98**	1.71**	–0.62***	–0.25	0.11	0.30*	0.13
	(1.89)	(2.42)	(2.62)	(2.58)	(2.25)	(–3.20)	(–1.37)	(0.58)	(1.76)	(0.65)
3	1.12*	1.57**	1.47**	1.25*	1.23*	–0.68***	–0.14	–0.13	–0.2	0
	(1.69)	(2.22)	(2.09)	(1.85)	(1.77)	(–3.77)	(–0.67)	(–0.76)	(–1.09)	(–0.00)
4	0.92	1.02	1.07	1.01	0.93	–0.72***	–0.59***	–0.26	–0.16	–0.02
	(1.42)	(1.47)	(1.56)	(1.45)	(1.34)	(–3.69)	(–3.13)	(–1.22)	(–0.80)	(–0.11)

Table 6 (*continued*)

Size Quintile	B/M quintile									
	Low	2	3	4	High	Low	2	3	4	High
Big	0.72	0.45	0.83	0.8	0.55	−0.41	−0.44**	−0.02	0.27	0.43**
	(1.04)	(0.72)	(1.16)	(1.19)	(0.86)	(−1.35)	(−2.44)	(−0.09)	(1.51)	(2.42)
	$R_t^p = \alpha_p + \beta_p^M (R_{M,t} - R_{f,t}) + \beta_p^{\text{HML}} \text{HML}_t + \epsilon_t^p$					$R_t^p = \alpha_p + \beta_p^{\text{SMB}} \text{SMB}_t + \beta_p^{\text{HML}} \text{HML}_t + \epsilon_t^p$				
Small	1.22***	1.20***	1.40***	1.26***	1.08***	0.68	0.63	0.94	0.52	0.44
	(3.56)	(3.23)	(4.01)	(2.70)	(2.60)	(0.97)	(0.91)	(1.33)	(0.74)	(0.58)
2	0.51**	0.82***	1.02***	1.08***	0.81**	0.29	0.57	0.63	0.75	0.37
	(2.06)	(3.04)	(3.07)	(3.47)	(2.47)	(0.40)	(0.82)	(0.90)	(0.97)	(0.50)
3	0.3	0.72***	0.61**	0.39	0.36	0.11	0.62	0.51	0.17	0.13
	(1.16)	(3.09)	(2.35)	(1.51)	(1.33)	(0.17)	(0.83)	(0.72)	(0.26)	(0.18)
4	0.09	0.16	0.22	0.16	0.07	0.18	0.23	0.36	0.28	0.15
	(0.41)	(0.72)	(1.14)	(0.80)	(0.33)	(0.27)	(0.32)	(0.50)	(0.38)	(0.21)
Big	−0.07	−0.35**	−0.03	−0.02	−0.2	0.61	0.16	0.7	0.66	0.57
	(−0.39)	(−2.08)	(−0.15)	(−0.11)	(−1.31)	(0.79)	(0.24)	(0.90)	(0.90)	(0.81)

The excess returns on the 25 portfolios formed on size and book-to-market ratios are regressed using six models. The sample period is from July 1995 to December 2016. The estimated intercepts α_p and the associated t-values for each portfolio are reported. The *t*-values are based on the Newey-West adjusted standard errors. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

Table 7 *F*-statistics and matching probability levels of bootstrap and *F*-distributions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
F-statistics	2.018	1.650	1.837	1.648	1.821	1.371	1.423
Probability level							
Bootstrap	0.992	0.883	0.977	0.928	0.985	0.720	0.786
F-distribution	0.996	0.969	0.989	0.969	0.988	0.881	0.906

Seven different factor models are tested: (1) $R_{pt}-R_{ft}=\alpha_p+\beta_p^M(R_{Mt}-R_{ft})+\epsilon_{pt}$; (2) $R_{pt}-R_{ft}=\alpha_p+\beta_p^{\mathrm{SMB}}\mathrm{SMB}_t+\epsilon_{pt}$; (3)$R_{pt}-R_{ft}=\alpha_p+\beta_p^{\mathrm{HML}}\mathrm{HML}_t+\epsilon_{pt}$; (4) $R_{pt}-R_{ft}=\alpha_p+\beta_p^M(R_{Mt}-R_{ft})+\beta_p^{\mathrm{SMB}}\mathrm{SMB}_t+\epsilon_{pt}$; (5) $R_{pt}-R_{ft}=\alpha_p+\beta_p^M(R_{Mt}-R_{ft})+\beta_p^{\mathrm{HML}}\mathrm{HML}_t+\epsilon_{pt}$; (6) $R_{pt}-R_{ft}=\alpha_p+\beta_p^{\mathrm{SMB}}\mathrm{SMB}_t+\beta_p^{\mathrm{HML}}\mathrm{HML}_t+\epsilon_{pt}$; (7) $R_{pt}-R_{ft}=\alpha_p+\beta_p^M(R_{Mt}-R_{ft})+\beta_p^{\mathrm{SMB}}\mathrm{SMB}_t+\beta_p^{\mathrm{HML}}\mathrm{HML}_t+\epsilon_{pt}$. The table reports the *F*-test results on the hypothesis that the intercepts, αs, are jointly zero across the 25 size-B/M sorted portfolios in the Chinese stock market, from July 1995 to December 2016. We also report the bootstrap probabilities based on 10,000 simulations.

size factor, that is, model (4) and model (6).[12] By comparison, we can reject the hypothesis that the intercepts for the 25 portfolios are all zeros for model (5), which includes only the market $R_M - R_f$ and the HML factors. Moreover, among the three 1-factor models (model (1), (2), and (3)), the *F*-statistics for the model with the size factor is the lowest, 1.65 with bootstrap probability of 0.883 and *F*-distribution probability of 0.969. By comparison, the *F*-statistics for another two 1-factor models are much larger, and we can reject the jointly-zero intercepts hypothesis for model (1) and model (3). Overall, SMB appears to be the most important factor in explaining cross-sectional returns in China's stock market.

B. Fama–MacBeth regressions

For asset pricing tests in this section, we follow the cross-sectional regression approach of Fama and MacBeth (1973). In the first-stage of the Fama–MacBeth regressions, we estimate individual stocks' exposures to the market, SMB and HML factors. To reduce noises in the estimation, we follow the literature and use a portfolio-based approach. At the end of June each year, we divided all nonfinancial stocks into 27 triple-sorted portfolios—the intersections of three portfolios independently sorted by size and by B/M ratios, then conditional on

12 For model (4), the *F*-statistics is 1.648 with a bootstrap probability of 0.928 and a *F*-distribution probability of 0.969. Therefore, we cannot reject the hypothesis that the intercepts for the 25 portfolios are all zeros using the bootstrap probability, but can reject the hypothesis that using the *F*-distribution probability (with 95% confidence level). Given the short-sample period, we think the bootstrap probability is more reliable.

the size-B/M portfolios, sorted by market beta. For each of the portfolios, the post-ranking betas are estimated by:

$$R_{pt}-R_{ft}=\alpha_p+\beta_p^M\left(R_{Mt}-R_{ft}\right)+\beta_p^{\mathrm{SMB}}\mathrm{SMB}_t+\beta_p^{\mathrm{HML}}\mathrm{HML}_t+\epsilon_{pt} \tag{2}$$

where R_{pt} is the equal-weighted return for portfolio p in month t and this regression is run over the entire sample period from July 1995 to December 2016. We then use each portfolio's full-sample post-ranking betas as the estimates for the individual stocks' betas on market, SMB, and HML.

In the second stage of the Fama–MacBeth regressions, we run a cross-sectional regression at each month t:

$$R_{it}-R_{ft}=\gamma_{0t}+\gamma_t^M\beta_i^M+\gamma_t^{\mathrm{SMB}}\beta_i^{\mathrm{SMB}}+\gamma_t^{\mathrm{HML}}\beta_i^{\mathrm{HML}}+\epsilon_{it} \tag{3}$$

where $R_{it} - R_{ft}$ is the excess returns of stock i at month t, β_i^M, β_i^{SMB}, and β_i^{HML} are our estimates of stock i's betas on market, SMB, and HML, respectively. Figure 3 plots the estimated monthly slopes, γ_t^M, γ_t^{SMB}, and γ_t^{HML}, and the associated 95% confidence interval of each month.

In a standard Fama–MacBeth regression, the factor premiums are estimated as the time-series average of γ^{M_t}, γ_t^{SMB}, and γ_t^{HML}. That is:

$$\begin{aligned}\gamma^{M,\mathrm{EW}}&=\sum_{t=1}^{N}\frac{1}{N}\gamma_t^M\\ \gamma^{\mathrm{SMB},\mathrm{EW}}&=\sum_{t=1}^{N}\frac{1}{N}\gamma_t^{\mathrm{SMB}}\\ \gamma^{\mathrm{HML},\mathrm{EW}}&=\sum_{t=1}^{N}\frac{1}{N}\gamma_t^{\mathrm{HML}}\end{aligned} \tag{4}$$

where N is the total number of months for the full sample period. In other words, the factor premiums are calculated as the equal-weighted averages of the estimated premiums of each month.

However, as shown in Figure 3, the estimated slopes on the three factors, $R_M - R_f$, SMB, and HML, do not have the same dispersions across time. For all three factors, we observe more extreme values during the first few years and these estimates are usually associated with wide dispersions due to small sample size. In addition, the estimated slopes also show larger dispersions during periods of market turmoil such as the 2008–2009 financial crisis period and the latest Chinese stock market turbulence which begins in the second half of 2015.

To take into account the noise associated with the monthly estimated slopes, we also estimate the factor premiums using the variance adjusted averages of the estimated slopes γ_t^M, γ_t^{SMB}, and γ_t^{HML}:

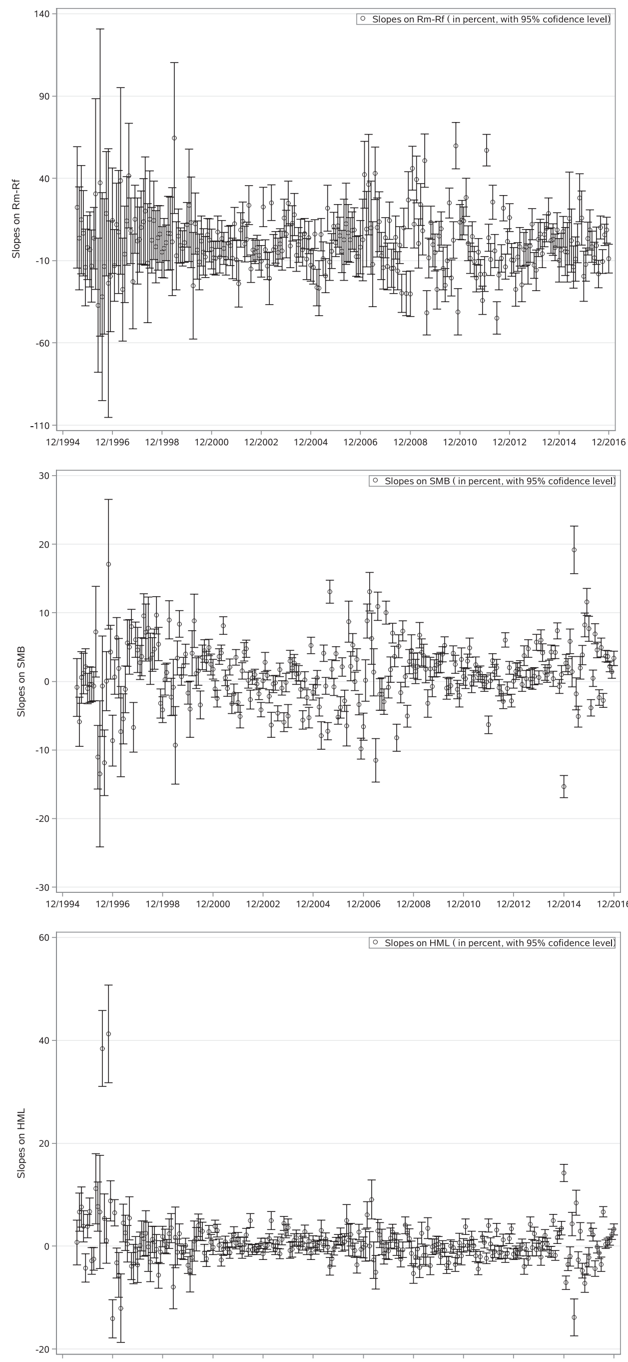

Figure 3 Month-by-month slopes on $R_M - R_f$, SMB, and HML in the Cross-sectional Fama–MacBeth regressions, from July 1995 to December 2016.

$$
\begin{aligned}
\gamma^{M,\mathrm{VW}} &= \sum_{t=1}^{N} \frac{1/\sigma^2\left(\gamma_t^M\right)}{1/\sigma^2\left(\gamma_1^M\right)+1/\sigma^2\left(\gamma_2^M\right)+\ldots+1/\sigma^2\left(\gamma_N^M\right)}\gamma_t^M \\
\gamma^{\mathrm{SMB},\mathrm{VW}} &= \sum_{t=1}^{N} \frac{1/\sigma^2\left(\gamma_t^{\mathrm{SMB}}\right)}{1/\sigma^2\left(\gamma_1^{\mathrm{SMB}}\right)+1/\sigma^2\left(\gamma_2^{\mathrm{SMB}}\right)+\ldots+1/\sigma^2\left(\gamma_N^{\mathrm{SMB}}\right)}\gamma_t^{\mathrm{SMB}} \\
\gamma^{\mathrm{HML},\mathrm{VW}} &= \sum_{t=1}^{N} \frac{1/\sigma^2\left(\gamma_t^{\mathrm{HML}}\right)}{1/\sigma^2\left(\gamma_1^{\mathrm{HML}}\right)+1/\sigma^2\left(\gamma_2^{\mathrm{HML}}\right)+\ldots+1/\sigma^2\left(\gamma_N^{\mathrm{HML}}\right)}\gamma_t^{\mathrm{HML}}.
\end{aligned} \tag{5}
$$

For the above equations, we estimate the factors' risk premiums as the value weight averages of the slopes, γ_t^M, γ_t^{SMB}, and γ_t^{HML}, where the weights are the inverse of the variance of the estimated slopes, $\sigma^2\left(\gamma_t^M\right)$, $\sigma^2\left(\gamma_t^{\mathrm{SMB}}\right)$, and $\sigma^2\left(\gamma_t^{\mathrm{HML}}\right)$, in the cross-sectional regression equation (3) at each month *t*, respectively.

Table 8 reports the estimated factor premiums of market $R_M - R_f$, SMB, and HML. Consistent with our earlier findings, only SMB shows significant risk premiums in the Fama–MacBeth regression tests. The estimated premium of SMB is 0.96% per month with *t*-value 4.39 using the variance-adjusted Fama–MacBeth regressions; the estimated premium of SMB is 1.09% per month with *t*-value 3.70 using the standard Fama–MacBeth regressions. In contrast, HML does not have significant risk premium. Using the standard Fama–MacBeth regressions, the estimated premiums is 0.56% per month with a *t*-value of 1.84, only marginally significant at the 10% level and not significant at the 5% level. More importantly, after taking into account the variances of the estimated premium at different time, the variance-adjusted premiums on the HML factor decreases to 0.17% per month with *t*-value of only 1.11. Lastly, the estimated premiums on the market factor $R_M - R_f$ are nonsignificant using both the standard and the variance adjusted Fama–MacBeth regressions.

In Table 8, we also test the robustness of the factor premiums by expanding equation (3) with various accounting variables:

$$
R_{it} - R_{ft} = \gamma_{0t} + \gamma_t^M \beta_i^M + \gamma_t^{\mathrm{SMB}} \beta_i^{\mathrm{SMB}} + \gamma_t^{\mathrm{HML}} \beta_i^{\mathrm{HML}} + \mathrm{controls}_{it} + \epsilon_{it}. \tag{6}
$$

The control variables include floating ratio, book leverage, market leverage, earnings, and dividend ratio. The results remain robust: SMB is the only factor which has significant risk premium, while the market and HML factors do not carry significant risk premiums. Using the variance-adjusted Fama–MacBeth regressions, the magnitude of the estimated SMB premium is in a narrow range from 0.96% to 1.06% per month for different control variables. The *t*-values of the estimated SMB premiums range from 4.23 to 5.80, suggesting that the positive premium of SMB is very robust. The standard Fama–MacBeth regressions show similar results.

C. Pooled regressions

In addition to the Fama–MacBeth regressions, we also tried pooled regressions by stacking the cross-section data across all time together. In the two-stage

Table 8 Fama–MacBeth regressions

Models	Intercept	$R_M - R_f$	SMB	HML	Floating Ratio	Ln(A/ME)	Ln(A/BE)	E(+)/P	E/P Dummy	DP	N	R^2
Panel A: Variance-adjusted Fama–Macbeth												
1	0.32	–0.83	0.96***	0.17							258	5.2
	(0.41)	(–0.90)	(4.39)	(1.11)								
2	0.02	–0.71	0.97***	0.16	0.32						258	5.93
	(0.02)	(–0.78)	(4.23)	(1.05)	(1.44)							
3	0.44	–0.82	0.95***	0.08		0.05					258	5.94
	(0.59)	(–0.95)	(4.40)	(0.65)		(0.58)						
4	0.3	–0.75	0.95***	0.15			–0.06				258	6.04
	(0.38)	(–0.82)	(4.44)	(1.02)			(–0.52)					
5	–0.05	–0.61	1.06***	0.09				0.03	–0.01		258	7.25
	(–0.07)	(–0.68)	(5.80)	(0.59)				(1.12)	(–0.09)			
6	0.16	–0.74	0.99***	0.12						0.07**	258	5.61
	(0.21)	(–0.82)	(4.71)	(0.82)						(2.32)		

Models	Intercept	$R_M - R_f$	SMB	HML	Floating Ratio	Ln (A/ME)	Ln (A/BE)	E (+)/P	E/P Dummy	DP	N	R^2
Panel B: Standard Fama–Macbeth												
1	–0.01	0.96	1.09***	0.56*							258	5.2
	(–0.01)	(0.90)	(3.70)	(1.84)								
2	–0.47	1.13	1.16***	0.52*	0.48						258	5.93
	(–0.50)	(1.06)	(3.69)	(1.80)	(1.07)							

Table 8 (*continued*)

Panel B: Standard Fama–Macbeth

Models	Intercept	$R_M - R_f$	SMB	HML	Floating Ratio	Ln (A/ME)	Ln (A/BE)	E (+)/P	E/P Dummy	DP	N	R^2
3	0.36	0.68	1.06***	0.29		0.25*					258	5.94
	(0.40)	(0.67)	(3.68)	(1.15)		(1.93)						
4	–0.05	1.01	1.05***	0.54*			0.04				258	6.04
	(–0.06)	(0.95)	(3.62)	(1.82)			(0.29)					
5	–0.61	1.31	1.22***	0.43				0.05	0.3		258	7.25
	(–0.61)	(1.22)	(5.07)	(1.42)				(1.35)	(0.98)			
6	–0.23	1.12	1.12***	0.52*						0.07*	258	5.61
	(–0.24)	(1.05)	(3.95)	(1.75)						(1.96)		

This table shows the estimated risk premiums of $R_M - R_f$, SMB, and HML using the Fama–MacBeth cross-sectional regressions. Individual stocks' betas are estimated as the full-sample betas of 27 triple-sorted portfolios by size, book-to-market ratio and CAPM beta. We then run cross-sectional month-by-month regressions of individual stocks' returns on their exposures to SMB, HML, and $R_M - R_f$, and other accounting variables as controls. The sample period is from July 1995 to December 2016. The *t*-values of the estimated risk premiums are reported in the square brackets below. *, **, and *** correspond to statistical significance at 10%, 5%, and 1%, respectively.

Table 9 Estimated risk premiums by pooled regressions

Parameter	(1)	(2)	(3)	(4)
Intercept	−0.42	3.48**	−0.66	3.74***
	(−0.36)	(2.54)	(−0.57)	(2.84)
$R_M - R_f$	1.2	−1.76	1.4	−1.99
	(0.88)	(−1.30)	(1.04)	(−1.50)
SMB	1.33***		1.35***	
	(4.30)		(4.50)	
HML	0.25			0.36
	(1.01)			(1.55)
N	253,491	253,491	253,491	253,491
R^2	0.14	0.004	0.13	0.01

Individual stocks' exposures to SMB, HML, and $R_M - R_f$ are first estimated as the full-sample betas of 27 triple-sorted portfolios by size, book-to-market ratio, and CAPM beta. Next, the equation $R_{it} - R_{ft} = \gamma_{0t} + \gamma_t^M \beta_i^M + \gamma_t^{SMB} \beta_i^{SMB} + \gamma_t^{HML} \beta_i^{HML} + \epsilon_{it}$ is estimated in one single OLS regression by pooling individual stock returns across all months from July 1995 to December 2016. T-values are estimated based on standard errors clustered by month and are reported in the square brackets. *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

Fama–MacBeth regressions, we run cross-sectional regressions using equation (3) at each month t and then use the time-series averages of the slopes as the estimated factor premiums. In the pooled regressions, we instead use one OLS regression to estimate the equation (3) across the sample of stock returns of all firms over the entire sample period from July 1995 to December 2016. Given that the error terms are likely to be cross-sectional correlated at a given month, we clustered the standard-errors at the month level. The pooled regression and the Fama–MacBeth regressions are indeed two similar approaches. Cochrane (2005) has shown that under certain technical conditions, the two approaches will have identical numerical results. Nevertheless, given that the Chinese stock market had few stocks and was more volatile in the early period, we think it is helpful to report the pooled time-series cross-section regression results as a further test.

Table 9 reports the estimated premiums and the t-statistics for the pooled regressions. The results are similar to the ones using the Fama–MacBeth approach. SMB has a robust positive risk premium of 1.33% per month with a t-value of 4.30, while the other two factors, $R_M - R_f$ and HML, do not have significant premiums. Moreover, the size factor can significantly improve the R^2 of the pooled regressions. The R^2 for the pooled regression with only the market factor is close to zero. Adding HML together with the market factor only improves the R^2 marginally to 0.01%. In contrast, when the size factor is included, the R^2 increases to 0.13%, confirming the strong explanatory power of the size factor in explaining the cross-section returns.

VI. ROBUSTNESS

A. Different sample periods and weighting schemes

Table 10 reports the average returns of the three factors, $R_M - R_f$, SMB, and HML, under different weighting schemes. For the sample period from July 1995

Table 10 Average returns of $R_M - R_f$, SMB, and HML under different weighting schemes and sample periods

Panel A: Equal weighted (July 1995 to December 2016)				Panel B: Equal weighted (July 1997 to December 2016)			
	$R_M - R_f$	SMB	HML		$R_M - R_f$	SMB	HML
Mean	1.12**	0.91***	0.71***	Mean	0.77	1.08***	0.35
T	(1.99)	(3.31)	(2.61)	T	(1.37)	(3.93)	(1.59)
Panel C: Variance adjusted (6-month rolling window, December 1995 to December 2016)				**Panel D: Variance adjusted (3-month rolling window, August 1995 to November 2016)**			
	$R_M - R_f$	SMB	HML		$R_M - R_f$	SMB	HML
Mean	0.78*	0.61***	0.32*	Mean	0.68*	0.73***	0.2
T	(1.70)	(2.63)	(1.85)	T	(1.68)	(3.69)	(1.28)
Panel E: Variance adjusted (6-month centered window, October 1995 to October 2016)				**Panel F: Sample size adjusted (July 1995 to December 2016)**			
	$R_M - R_f$	SMB	HML		$R_M - R_f$	SMB	HML
Mean	0.48	0.66***	0.25	Mean	0.82	1.15***	0.35
T	(1.12)	(3.07)	(1.49)	T	(1.54)	(4.23)	(1.50)

The time-series averages of the returns on the three factors $R_M - R_f$, SMB, and HML, under different weighting schemes are reported. For Panel A and Panel B, the average returns are the equal weighted averages of the monthly returns. For Panel C, the average returns are the inverse-variance weighted averages of the monthly returns, where the weights are the annualized variance of daily returns during a 6-month rolling window. For Panel D, the average returns are the inverse-variance weighted averages of the monthly returns, where the weights are the annualized variance of daily returns during a 3-month centered window. For Panel E, the average returns are the inverse-variance weighted averages of the monthly returns, where the weights are the annualized variance of daily returns during a 6-month centered window. For Panel F, the average returns are the sample size weighted averages of the monthly returns, where the weights are the number of listed firms on the Shanghai and Shenzhen exchanges. The t-values are reported in the square brackets. *, **, and *** denote the significance at the 10%, 5%, and 1% level, respectively.

to December 2016, the simple equal weighted average of SMB is 0.91% per month with a t-value of 3.31. Therefore, similar to our main results which are based on variance adjusted average returns, the results suggest that SMB is a robust and significant factor in the Chinese stock market. The simple equal-weighted average of HML is 0.71% per month with a t-value 2.61 from July 1995 to December 2016. Although this seems to suggest that HML has significant premiums, we find that the statistical significance of HML is very fragile. The results are largely driven by a few outliers in the first 2 years, when the number of listed firms was small and the market was extremely volatile. In fact, if we start the sample period a few years later to July 1997, the equal weighted average of HML reduces to 0.35% per month and is no longer statistically significant. The market factor $R_M - R_f$ shows similar pattern. Even though the simple equal weighted average of the market factor $R_M - R_f$ is 1.12% per month with a marginal t-value of 1.99 for the full sample which starts from July 1995, the average decreases to 0.77% with a t-value of only 1.37 after we remove the first 2 years from the sample.

Moreover, after weighting the monthly returns by the inverse of the variance, HML no longer shows positive premiums that are statistically significant at the 5% level. In addition to the main results discussed before, we also try three different ways to estimate the variance of the returns on HML at each month t: variance of daily returns in a 6-month rolling window from the beginning of month t–5 to the end of month t, variance of daily returns in a 3-month centered window from the beginning of month t–1 to the end of month t+1, and variance of daily returns in a 6-month center window from the beginning of month t–3 to the end of month t+2. For all these variance estimating approaches, the variance adjusted average returns of HML are not statistically significant at the 5% level, suggesting that the significant positive equal-weighted average is largely driven by a few large observations when HML has high variance and hence low precision. We also report the sample size weighted time-series average of HML returns, where weights are the number of listed firms on SSE and SZSE. The sample size adjusted weighted averages will give less weights to the observations from the earlier period when there was a limited number of stocks. After being adjusted by the sample size, the average of the HML returns reduces to 0.35% per month with an insignificant t-value 1.50. Combining these evidences, we conclude that HML does not carry significant risk premiums.

By comparison, we find that SMB has very robust positive average returns. The variance adjusted average returns of SMB range from 0.61% per month to 0.73% per month under different variance estimators. The sample size adjusted average return of SMB is 1.15%, and the equal weighted average return of SMB is 1.08%. All of the estimated average returns of SMB are statistically significant at the 1% level, suggesting that SMB has a robust positive premium.

B. Alternative splits to construct SMB and HML

For the construction of SMB and HML, we follow Fama and French (1993) to sort firms into three groups on B/M and only two groups on size. The split itself is arbitrary. In fact, the main motivation of Fama and French (1993) is the observation that B/M has a stronger role in average stock returns in the US market. On the other hand, our previous discussion shows that, in the Chinese market, size can help explain average returns while B/M cannot. Thus, we tried two alternative splits for the construction of SMB and HML factors. The first split is to independently sort firms into two groups on size (Small and Big) and two groups on B/M (Low and High) at the end of June of each year. The intersections generate four portfolios: Small-Low, Small-High, Big-Low, and

Big-High. The monthly returns of the four portfolios are the value-weighted average of individual stock returns, in which the weights are floating A-share market capitalizations at the portfolio formation time. SMB is the difference between the simple average of the returns on the two small-stock portfolios (Small-Low and Small-High) and the two big-stock portfolio (Big-Low and Big-High).

The second split is similar, except that we sort firms into three groups on size (Small, Medium, and Big) and two groups on B/M (Low and High). The three size portfolios represent the bottom 30%, middle 40% and top 30% of stocks ranked on the basis of size. The intersections generate six portfolios: Small-Low, Small-High, Medium-Low, Medium-High, Big-Low, and Big-High. SMB is the difference between the simple average of the returns on the two small-stock portfolios (Small-Low and Small-High) and the two big-stock portfolio (Big-Low and Big-High).

Table 11 summarizes the Fama–MacBeth results for the above 2-by-2 and 3-by-2 splits. The estimated premium for the size factor is 0.75% per month with *t*-value 4.67 for the 2-by-2 split and 1.06% per month with *t*-value 4.62 for the 3-by-2 split. The results confirm the robust positive premium of the size factor. The average premiums for SMB are of slightly smaller magnitude as our main results, and remain positively significant. The estimated premiums for the market factor $R_M - R_f$ and HML remain not statistically significant at the 5% level.[13] Our main conclusions are thus robust to different splits in the construction of size and value factors.

C. Alternative definition of size

Due to the "split-share structure," Chinese-listed firms often have both floating shares and nonfloating shares. In the main part of this paper, we define a firm's size as the floating A-share market capitalization because regular investors can only publicly trade floating A shares. However, some papers do use the total market capitalization to define size. To compare our results with them on an equal footing, we test the robustness of our main results for different measures of size.

Definition of size affects the construction of $R_M - R_f$, SMB, and HML factors in two dimensions. First, it determines individual stocks' ranking when we form two size portfolios: Small and Big. Second, the relative weights for individual stocks within a portfolio, for example, market, Small-Low, Small-Medium, Small-High, Big-Low, Big-Medium, and Big-High, are determined by their size. Hence, we have in total of six combinations: rank by floating capitalization and weight by floating capitalization, rank by floating and weight by total, rank by

13 We also tried the standard Fama-MacBeth regressions. The results are similar to the variance adjusted Fama-MacBeth results which we report in the paper.

Table 11 Alternative splits to construct SMB and HML

	2 × 2 Split				3 × 2 Split			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Intercept	0.24	0.32	1.26	1.23	0.29	0.37	0.71	0.65
	(0.30)	(0.40)	(1.57)	(1.50)	(0.36)	(0.47)	(0.90)	(0.81)
Mkt	–0.65	–0.74	–1.09	–1.04	–0.71	–0.8	–0.54	–0.46
	(–0.71)	(–0.81)	(–1.21)	(–1.15)	(–0.77)	(–0.88)	(–0.59)	(–0.50)
SMB	0.75***	0.72***			1.06***	1.02***		
	(4.67)	(4.41)			(4.62)	(4.42)		
HML	0.17			0.17	0.18*			0.19*
	(1.61)			(1.53)	(1.69)			(1.76)
N	258	258	258	258	258	258	258	258
R^2	5.25	3.64	0.62	2.36	5.25	3.65	0.63	2.36

The variance adjusted Fama–MacBeth regression results are reported for different splits to construct SMB and HML factors. The sample period is from July 1995 to December 2016. In the left panel, stocks are sorted on the basis of size into two groups (Small and Big) and two groups on B/M ratios (Low and High) at the end of June of each year. The intersections generate four portfolios: Small-Low, Small-High, Big-Low, and Big-High. SMB is the difference between the simple average of the returns on the two small-stock portfolios (Small-Low and Small-High) and the two big-stock portfolios (Big-Low and Big-High). In the right panel, stocks are sorted into three groups on size (Small, Medium, and Big) and two groups on B/M (Low and High). The three size groups represent the bottom 30%, middle 40%, and top 30% of stocks ranked on the basis of size. The intersections generate six portfolios: Small-Low, Small-High, Medium-Low, Medium-High, Big-Low and Big-High. SMB is the difference between the simple average of the returns on the two small-stock portfolios (Small-Low and Small-High) and the two big-stock portfolio (Big-Low and Big-High). The t-values are reported in the square brackets. *, **, and *** denote the significance at the 10%, 5%, and 1% level, respectively.

Table 12 Alternative definition of size

Weighted by	Sorted by floating cap			Sorted by total cap		
	Floating	Total	Equal	Floating	Total	Equal
Intercept	0.32	0.05	0.65	1.11	0.74	1.78**
	(0.41)	(0.07)	(0.78)	(1.28)	(0.88)	(2.03)
$R_M - R_f$	–0.83	–0.71	–0.5	–1.66	–1.46	–1.72
	(–0.90)	(–0.82)	(–0.48)	(–1.64)	(–1.49)	(–1.59)
SMB	0.96***	1.13***	0.74***	0.95***	1.07***	0.74***
	(4.39)	(4.47)	(4.67)	(4.38)	(4.33)	(4.78)
HML	0.17	0.14	0.19	0.14	0.12	0.16
	(1.11)	(0.83)	(1.35)	(0.92)	(0.71)	(1.11)

Definition of size affects the construction of $R_M - R_f$, SMB, and HML factors in two dimensions: individual stocks' rank in size and their relative weights in a portfolio. Six different methods are examined: rank by floating capitalization and weight by floating capitalization, rank by floating and weight by total, rank by floating and weight equally, rank by total and weight by floating, rank by total and weight by total and rank by total and weight equally. The variance adjusted Fama–MacBeth regression results are reported for sample period from July 1995 to December 2016. The *t*-values are reported in the square brackets. *, **, and *** denotes the significance at the 10%, 5%, and 1% level, respectively.

floating and weight equally, rank by total and weight by floating, rank by total and weight by total, and rank by total and weight equally.

The Fama–MacBeth results for the above six cases are summarized in Table 12. Different ranking and weighting schemes produce similar SMB factors. The estimated risk premiums of SMB range from 0.74% to 1.13% per month and are all statistically significant. On another hand, $R_M - R_f$ and HML donot have significant premiums in all cases.

D. Comparison with the literature

Our main results can be summarized as (i) strong size effect—smaller firms, on average, have higher returns than bigger firms; and (ii) no value effect—value and growth firms do not have significantly different returns. Though the literature agrees on the strong size effect, the findings on the value effect are mixed. Consistent with our results, Wang and Xu (2004) and Hilliard and Zhang (2015) also find no value effect in the Chinese stock market. On another hand, some of the existing literature document significant value effect, including Cakici et al. (2015a), Chen et al. (2010), Carpenter et al. (2014), Cakici et al. (2015b), Cheung et al. (2015), Wang and Di Iorio (2007), Wong et al. (2006), Wu (2011), Eun and Huang (2007), Huang and Yang (2011), Chen et al. (2007), and Morelli (2012).

We believe the differences are mainly due to the choices of sample periods. In fact, once we use the same sample periods, the standard equal-weighted sample averages of our HML factor exhibit similar statistic properties as those reported in the existing studies.[14] This suggests that data quality and variation in the empirical procedures (such as equal-weighted versus value weighted portfolios, different splits on size and B/M ratios, and etc.) do not play an important role here. The differences between the existing studies, including ours, are mainly due to different sample periods.

Given the relative short sample period and the fast-changing market conditions, we want to emphasize that many of the standard approaches are not suitable for asset pricing tests in the Chinese stock market. For example, the standard equal-weighted average would be a poor estimate of the expected risk premium. Excluding year 1995 and 1996, the equal-weighted averages of the HML premiums from 1997 to 2016 drops to only 0.35% per month with a *t*-value of 1.59, which is no longer statistically significant from zero. Therefore, we should be cautious on the robustness of the value effect documented in the existing studies, as most of them rely on the standard approaches used for the United States and other developed financial markets. The statistic significance could be largely driven by extreme estimates during the early years when the number of stocks was small and the market was very volatile.

To address potential biases associated with short sample period, we proposed several improvements on the empirical procedure in the paper. One approach is to use variance adjusted averages to estimate the expected risk premiums. The variance adjusted averages of HML shows consistently that HML does not have significant risk premiums during most of the sample periods used in the existing studies. The three exceptions are: 1995–2007 for Chen et al. (2010), 1997–2008 for Huang and Yang (2011), and 1997–2006 for Morelli (2012). These sample periods vary from 9 to 12 years, only around half of the total history of the Chinese stock market, and do not cover the recent period since 2008. Thus, these evidence supports our paper's claim that the HML premium is not definitive in the Chinese stock market.

VII. CONCLUSIONS

We find stock returns are strongly related to firms' size in the Chinese market. On average, small stocks outperform large stocks. A long-short portfolio which longs the smallest size portfolio and shorts the largest size portfolio earns a variance adjusted average returns of 1.23%, which is strongly statistically significant. Following the classic Fama–French methodology, we construct a zero-cost portfolio, SMB, to mimic the strong size effect in the cross-section returns. SMB

14 There are only three exceptions, Cheung et al. (2015), Wu (2011), and Chen et al. (2007), where we find that the equal-weighted averages of the monthly HML premiums in the respective sample periods are not statically significant from zeros at the 10% level. Among these three papers, Cheung et al. (2015) use only large and mid-cap stocks in the Chinese stock market; Wu (2011) uses only Shanghai Stock Exchange stocks; and Chen et al. (2007) use sample period from 1998 to 2001 which contains only 3 years. These factors may contribute to the reason why the equal-weighted averages of our HML premiums are not significant in our replications.

earns a variance adjusted average return of 0.61 per month, not only economically large but also statistically significant. In contrast, stocks' average returns do not exhibit clear relation with their book-to-market ratios. The factor mimicking portfolio for the book-to-market ratios, HML, generates a variance-adjusted average return of 0.23 per month, positive but not statistically significant. The market factor, $R_M - R_f$, also does not have significant premium. Moreover, SMB consistently beats the market and HML factors in both time-series regressions and Fama–MacBeth cross-sectional tests. Among the three factors, SMB is the most important in terms of capturing cross-sectional variations in Chinese stock returns. Our results contradict some previous literature which documented strong size and value effect. We find that the previous documented value effect is not robust and is largely caused by a few extreme months during the early period which has a limited number of list firms and extreme high volatilities.

Grace Xing Hu
818 KKLeung Building
School of Economics and Finance
University of Hong Kong and CAFR
gracehu@hku.edu

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