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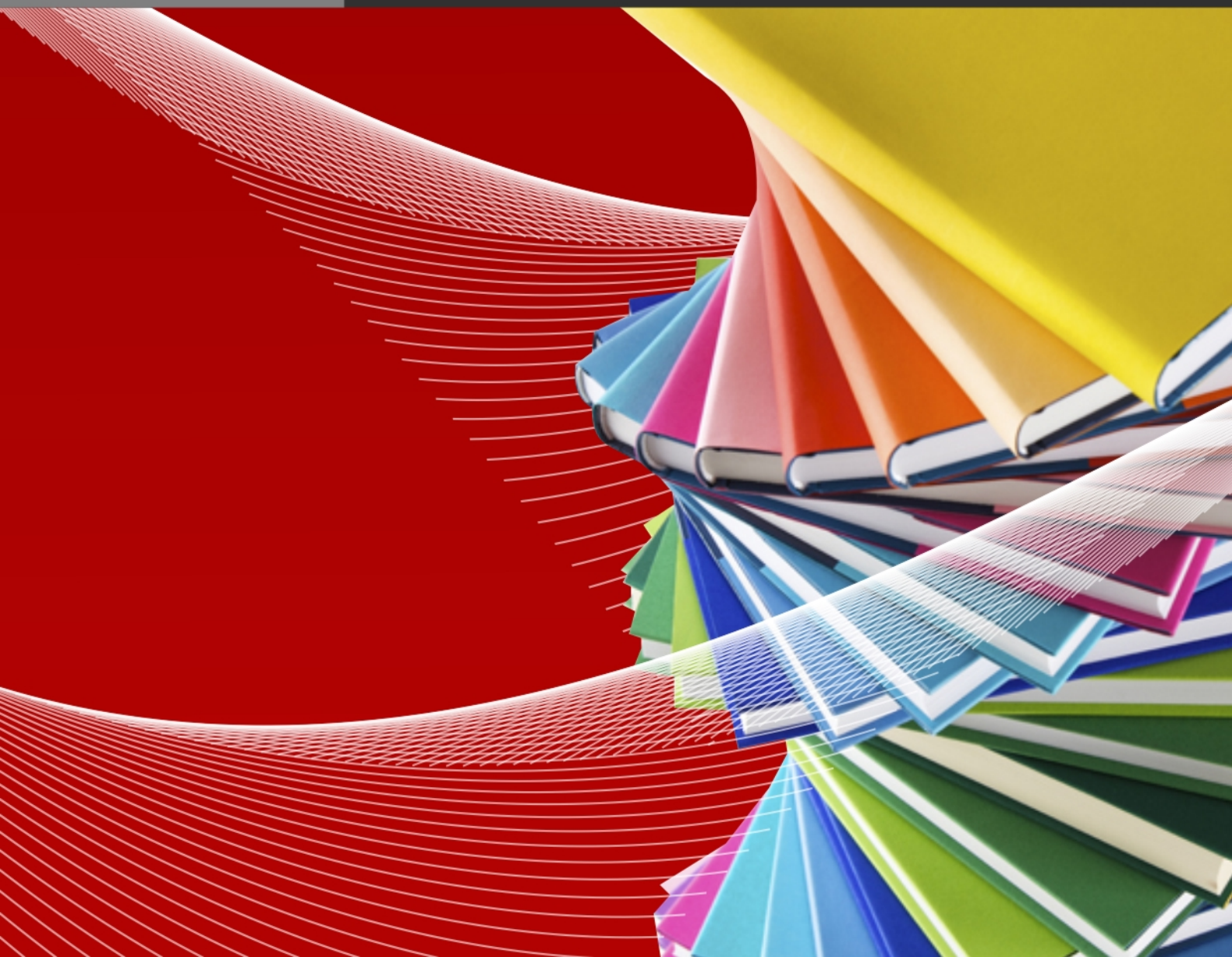

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FACULTY OF BUSINESS ADMINISTRATION

BETTING AGAINST BETA: EVIDENCE FROM CHINA

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Abstract

Frazzini and Pedersen (2014) propose that investors with borrowing constraints will tilt toward risky stocks in portfolio construction, driving lower alpha for high-beta stocks. They further find that the betting against beta (BAB) portfolio of buying stocks with low beta and selling stocks with high beta produces a significantly positive annualized risk-adjusted return of 8.76% in U.S. market. This study investigates the BAB investment strategy in the Chinese market. Consistent with Frazzini and Pedersen (2014), I have the following five major findings. (1) The phenomenon of high-beta stock associated with low-alpha exists in China. (2) The BAB portfolio produces a significant annualized return up to 5.28% in China. The bans on margin trading and short selling were lifted on March 31, 2010. By utilizing this special institutional setting, I find that (3) the removal of stock-specific margin constraints mitigates the low-alpha phenomenon for high-beta securities. (4) The time-varying funding constraints negatively influence BAB returns. (5) The dispersion of beta tends to drop and the conditional market beta exhibits a U-shaped pattern when the funding liquidity risk increases.

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1. Introduction

A recent study by Frazzini and Pedersen (FP 2014) proposes a model predicting that investors facing leverage and margin constraints tend to bid up the high-beta securities, driving lower risk-adjusted return for high-beta securities. They find that the unconstrained investors can use leverage or deleverage to exploit the arbitrage profits by constructing betting against beta (BAB) portfolio of buying stocks with low beta and selling stocks with high beta. They show that the BAB investment strategy produces a significantly positive annualized risk-adjusted return of 8.76% in the U.S. market. However, to my best knowledge, no study ever explores the BAB investment strategy in China. Although China is a developing country, its stock market grows rapidly in recent years. In terms of the total market capitalization, Shanghai Stock Exchange (RMB 24,400 billion) and Shenzhen Stock Exchange (RMB 12,860 billion) rank at fifth and eighth respectively in the world[1]. For this reason, it is worth for us to realize how the Chinese stock market behaves. FP model explains the phenomenon of high-beta securities associated with low-alpha by the investor-specific margin constraints. Although they show the constrained investors tend to hold more risky securities, they do not examine the direct linkage between margin constraints and security alpha. My thesis aims to fill this research gap by exploring the direct relationship between margin constraints and securities alpha. Since China imposed the bans on margin trading and short selling, all investors (constrained and unconstrained) were not allowed to do margin trading and short selling until March 31, 2010. Even when the bans were lifted, only certain securities are allowed for margin trading and short selling. In fact, Chinese investors face more severe margin constraints than U.S investors as they suffer the stock-specific margin constraints. The unique dataset with stock-specific margin

[1] The information is obtained from the Shanghai and Shenzhen Stock Exchange official website as of 31 December 2014:
http://www.sse.com.cn/aboutus/sseintroduction/introduction/
http://www.szse.cn/main/aboutus/bsjs/ldzc/index.shtml

constraints in China helps to facilitate finer test of the impact of borrowing constraints on the explored risk-return relation. Basically, I utilize this unique dataset to study the direct relationship between margin constraints and security alpha, which is not examined by FP.

In this study, I follow FP to examine the BAB investment strategy in China. The sample period covers from July 1993 to June 2014.

Firstly, I follow FP to rank the stocks in ascending order based on the past one year ex-ante betas at the beginning of each calendar month and assign the stocks to decile portfolios. In each portfolio, I calculate the corresponding excess return, CAPM alpha, three-factor alpha, four-factor alpha, Sharpe ratio etc. I find that the phenomenon of high-beta associated with low-alpha indeed exists in Chinese stock market: the excess return decreases as beta increases. When controlling for the CAPM, Fama and French (1993) three-factors and Charhart (1997) momentum factor, the alpha declines significantly as beta rises. Almost all the significantly positive returns appear in low-beta portfolios, while the negative returns appear in high-beta portfolio. Besides, Sharpe ratio is also higher in low-beta portfolios. In fact, the results indicate that the investors may obtain some profits by buying the low-beta portfolios and selling the high-beta portfolios. This also provides a motivation for my further study on the performance of BAB investment strategy.

Secondly, I construct the BAB portfolio based on the method proposed by FP. Basically, I assign the stocks to either low-beta or high-beta portfolio based on the past one year ex-ante beta from rolling regression. For example, if the ex-ante beta of a stock is lower (higher) than the median of cross-sectional ex-ante beta, the stock is assigned to low-beta portfolio (high-beta portfolio). Moreover, the individual stock returns are weighted by the ranked betas, where the

lower-beta securities have higher weights in the low-beta portfolio and higher-beta securities have higher weights in the high-beta portfolio[2]. Besides, the low-beta (high-beta) portfolio return is leveraged (deleveraged) by its portfolio beta. I find BAB portfolio works in China as it produces a significant annualized excess return up to 5.28%.

Thirdly, I perform a series of robustness tests. (1) The annualized risk-adjusted CAPM alpha, three-factor alpha and four-factor alpha of the BAB portfolio are 4.2%, 6.12% and 6.12% respectively, which are all statistically significant (at least at 10% level). (2) The significant BAB return is mainly driven by the long-side of the low-beta securities rather than the short-side of high-beta securities, which means the performance of BAB portfolio is less affected by the bans on short selling. (3) After I rank the stocks in ascending order based on the firm size (total market value) and assign them into five groups, I discover that the BAB portfolio performs better in big firms group. The BAB portfolio produces a monthly significant excess return of 0.51% in portfolio 5 (big firms) and the return remains significantly positive even when controlling for CAPM, three-factors and four-factors model. (4) Quintile and decile BAB investment strategy[3] can also produce significant risk-adjusted return[4]. (5) The BAB portfolio can generate monthly significant excess return of 0.51% when controlling for the January effect. (6) The sub-period test shows that the BAB investment strategy only works after the Chinese split share reform in 2005. (7) The BAB portfolio still can generate significant return even when changing the rebalancing frequency from monthly to annual. (8) I track the performance of BAB investment

[2] The weights are determined by the rank of the beta and the average rank. Basically, if the ranked betas are more deviated from the average rank, the returns will be weighted more heavily. For more details, please refer to the numerical example in Section 4.

[3] Quintile (Deciles) strategy refers to long the bottom 20% (10%) of the low-beta securities and short the top 20% (10%) of the high-beta securities.

[4] The BAB excess returns, CAPM alpha, three-factor alpha and four-factor alpha for quintile strategy are all statistically significant (at least at 10% level). However, only three-factor alpha and four-factor alpha are significant for decile strategy.

strategy up to 36 months following the portfolio formation date. I find the BAB return tends to drop after the occurrence of the highest return regardless of the rebalancing frequency (monthly or annual).

Fourthly, I develop a difference-in-difference (DID) regression to capture the effects of stock-specific margin constraints on stocks. China lifted the bans on margin trading and short selling in March 2010. I am interested in investigating how the alpha is influenced through its associated beta by this special institutional setting. I calculate the ex-ante alpha and beta based on the rolling regression (CAPM). Then, I regress the ex-ante alpha on ex-ante beta and a series of dummy variables that measure the time and stock eligibility for margin trading and short selling. In this DID regression, I find the short selling effects dominate the margin trading effects in China, which is consistent with the findings from Sharif, Anderson and Marshall (2014). Moreover, I find the ex-ante alpha and beta are negatively correlated, which supports my first findings that the phenomenon of high-beta securities associated with low-alpha exists in China. However, the lifted stock-specific margin constraints mitigate the low-alpha phenomenon for high-beta securities. Besides, I investigate how the margin trading level influences the securities. I use the past 12 months rolling sum of the margin trading amounts divided by year-end tradable/negotiable market value to measure the margin trading level. I find the alpha of high margin trading securities increases more through its beta compared with the low margin trading securities, suggesting that the high margin trading level further alleviates the low-alpha phenomenon for high-beta securities. In addition, I also add the short selling level as a control variable, but I find no evidence to show short selling level affects the securities alpha through its associated beta. By utilizing the Chinese special institutional setting of the stock-specific margin constraints, I study the direct relationship between alpha and the margin constraints that are not

examined by FP. I find (1) the relationship between beta and alpha is negative, which supports FP's model that high-beta securities are associated with low-alpha. (2) After the stocks are added into the designated list for margin trading, the phenomenon of high-beta securities associated with low-alpha is mitigated. This also supports FP's model that the low alpha – high beta phenomenon is driven by the margin constraints. (3) The alpha of high margin trading securities increases more than the low margin trading securities as beta increases.

Fifthly, I follow FP to explore how the BAB return is influenced when the funding constraints tighten. To measure the funding constraints in China, I use the difference between one-year Shanghai Interbank Offered Rate (SHIBOR) and one-year risk-free rate. Basically, the funding constraints are more binding when the spread becomes widen. In a regression of BAB return on funding constraints spread, I find that the BAB return inclines to drop when the funding constraints become more binding. The results show the similar conclusion even when I include a series of control variables. In fact, BAB portfolio requires investors to borrow or lend at risk-free in order to leverage the low-beta portfolio or deleverage the high-beta portfolio. It is not surprised to know that the BAB return is affected when the funding constraints tighten.

Finally, I use the same method proposed by FP to test how the market beta changes when the funding liquidity risk varies. I use the volatility of funding constraints spread (SHBIOR – risk-free rate) as a proxy to measure the funding liquidity risk. Moreover, I use standard deviation, mean absolute deviation and interquintile range to measure the cross-sectional dispersion of beta under different credit market condition. I find the dispersion of beta tends to decrease when the funding liquidity risk increases, which means that the beta are compressed toward one. This result is consistent with FP. Besides, I run a regression of BAB return on market return based on different funding liquidity environment. I find the conditional market

beta exhibits a U-shaped pattern, which is inconsistent with FP as they claim the conditional market beta should increases monotonically as the funding liquidity risk increases. One of possible explanations caused this inconsistency is the short sample period problem of SHIBOR, which is only available after October 2006. However, the time-series BAB returns are available from June 1994 to July 2014, which means I need to abandon half of the time-series BAB returns in order to match the sample period of SHIBOR for measuring the funding liquidity risk when running the regression.

In sum, I find the phenomenon of high-beta securities associated with low-alpha exists in China. Thus, the BAB investment strategy can produce significant return. This strategy is robust to the control of CAPM, three-factor and four-factor model. Even when changing the rebalancing frequency, taking into the consideration of January effect, longing/shorting a proportion of securities to construct the BAB portfolio etc., the BAB investment strategy still can produce significant return. Besides, by utilizing the special institutional setting of China, I find that the lifted stock-specific margin constraints mitigate the low-alpha condition for high-beta securities. The funding constraints bring negative impacts to the BAB return. Last but not least, an increase in funding liquidity risk decreases the dispersion of beta and the conditional market beta exhibits a U-shaped pattern.

My study examines the direct relationship between the alpha and margin constraints that is not studied by FP. Although FP shows the constrained investors tend to hold more risky securities that may lead to lower alpha for high-beta securities, the direct linkage between alpha and margin constraints is unclear. The major contribution of this study is to fill this research gap by utilizing the Chinese special institutional setting of stock-specific margin constraints. My findings support FP model that the phenomenon of high-beta securities associated with low-

alpha is driven by the margin constraints. Moreover, I find that the margin trading volume positively affects securities alpha through its associated beta. Besides, my study provides an insight for those unconstrained arbitrageurs. First, they can construct the BAB portfolio to exploit the arbitrage profits and eliminate the market inefficiency. Second, investors may have a better understanding of how the Chinese margin trading and short selling policy affect the securities in China. Third, they also realize the funding constraints are one of the barriers that may prevent them profiting from BAB portfolio. Forth, they know the dispersion of beta tends to decrease when the funding liquidity risk increases. Therefore, they should not leverage the low-beta portfolio or deleverage the high-beta portfolio too much during the high liquidity risk condition.

My thesis is organized as follows: Section 2 provides a brief literature review. Section 3 presents the data used in this study and introduces the methodology employed. Section 4 presents the empirical findings and gives the explanations of the results. Section 5 tests the robustness of BAB investment strategy. Section 6 examines the direct relationship between alpha and margin constraints. Finally, section 7 concludes this study.

2. Literature Review

2.1 Classical Portfolio Theory

Markowtiz (1952) introduces modern portfolio theory (MPT), a model concerning the risk-return relation of a portfolio. MPT suggests all the investors are risk averse and only make investment decisions based on two factors: risk and return. Therefore, investors' utility curves are described by risk and return and investors make investment decisions based on maximizing

their utility. Given the capital market and under the condition that investors can borrow or lend at risk-free rate without constraints, rational investors should always make their investment decision along with the capital market line (CML). This means investors should always hold a combination of the risk-free asset and the diversified market portfolio (two-fund separation theorem).

Treynor (1961, 1962), Sharpe (1964), Linter (1965), and Mossin (1966) develop the capital asset pricing (CAPM) based on Markowtiz (1952) MPT framework. CAPM helps to determine an appropriate expected return of an asset. This model suggests that the expected return of an asset is driven by the expected return of a risk-free asset and the risk premium of a diversified market portfolio. Since the firm-specific risk can be diversified away, investors should only be compensated for the non-diversifiable market risk that is measured by the sensitivity factor-beta. CAPM also assumes investors are rational and risk averse and they can borrow or lend an unlimited amount at risk-free rate given the capital market.

2.2 The Relationship between Risk and Return

Black, Jensen, and Scholes (1972) find the estimated slope of security market line (SML) is less than what CAPM suggests in an empirical test of CAPM for US market, which means the SML is too flat comparing with CAPM prediction. In other words, the high-beta securities require less risk-adjusted return than it should be. Black (1972) develops another version of CAPM, which does not allow investors to borrow or lend at risk-free rate. In fact, this model explains SML better. This means the "too flat" phenomenon is mitigated. However, Roll (1977) criticizes the empirical test and claims that the market index used in the test is not the market

portfolio but a proxy, thus CAPM can never be tested as the true market portfolio is never observable.

Haugen and Heins (1975) claim the high volatile securities do not necessarily reward more return. They find an empirical evidence to show the low-beta and low-volatility firms tend to have positive alpha in U.S. market. Fama and French (1992) show the risk-return relation is flat, and even negative especially when the market beta is the only explanatory variable for the return. Falkenstein (1994) finds that there is negative relationship between the expected return and the variance for NYSE&AMEX stocks in the past 30 years. This shows that the high volatile stocks are associated with low expected return. Ang, Hodrick, Xing, and Zhang (2006, 2009) also have similar findings. They find the stocks with high idiosyncratic volatility tend to have low expected return in U.S. market. In order to show this phenomenon does not only exist in U.S. market, they sort the stocks based on idiosyncratic volatility across 23 developed countries and assign them into five groups. The difference in average return between the highest volatile group and the lowest volatile group is negative 1.31% per month, when controlling Fama and French (1993) three-factors. This proves high volatile stocks associated with low expected return is a global phenomenon.

2.3 The Effects of Margin Trading and Short Selling

Garleanu and Pedersen (2011) develop the margin-based CAPM, which shows high margin requirement assets require higher return holding all else constant, especially when the funding constraints tighten. Seguin (1990) studies the impacts of addition for marginable securities in U.S. market. He finds that the margin eligibility enhances the information transmission. Therefore, the volatility and noise decrease once the securities are added to

marginable list. He also claims that the value of firms increases by 2% upon the announcement of margin eligibility.

China relieved the ban on margin trading and short selling in March 2010, which allows the stocks that are on designated list for margin trading and short selling. Chang, Luo and Ren (2014) find the stocks have negative event returns when they are added in designated list. Moreover, they claim the price efficiency improves and the return volatility decreases after the ban was lifted. Sharif, Anderson and Marshall (2014) study the effect of margin trading and short selling on Chinese market. They find evidences to show that short selling effects dominate the margin trading effects, as the prices of shortable and marginable stocks drop more than those of ineligible for margin trading and short selling securities that have similar characteristics. Besides, they show that the liquidity decreases and bid-ask spread increases for stocks that are eligible for margin trading and short selling, which indicates the uninformed investors are reluctant to trade marginable and shortable stocks in order to prevent or reduce the risk of trading with informed investors [Ausubel (1990)].

2.4 Recent Study on Betting Against Beta (BAB) Portfolio

Frazzini and Pedersen (FP 2014) claim that the phenomenon of high-beta securities associated with low risk-adjusted return can be explained by individual-specific leverage and margin constraints. Since constrained investors cannot use leverage or borrow at risk-free rate to suit their risk and return preference, they tend to bid-up and overweight the high-beta securities if they would like to achieve higher return, which make the risk-adjusted return for high beta securities lower. It also means the constrained investors are no longer holding the efficient

market portfolio and make their investment decision along with the CML. Therefore, the market inefficiency occurs and arbitrage opportunity arises. Basically, FP model has five central predictions: (1) high-beta security is associated with low-alpha due to the constrained investors bid up the high-beta securities that drive lower alpha. (2) BAB portfolio can generate significant return. (3) Funding constraints negatively affect BAB return. (4) The beta is compressed toward one when funding liquidity risk is high. (5) Constrained investors tend to hold riskier securities.

FP model shows the unconstrained investors can use leverage or deleverage to exploit the profit by constructing betting against beta (BAB) factor. BAB strategy means to long the low beta assets and short the high beta assets at the same time, as well as utilize the leverage and deleverage to achieve market-neutral self-financing portfolio. They find significant positive BAB returns across different class of assets in US market. Moreover, they also do the test for the international equities and the BAB returns remain significant positive. Even when controlling Fama and French (1993) three-factors, Charhart (1997) momentum factor and Pastor and Stambaugh (2003) liquidity factor, significant positive BAB returns still exist. Besides, they find that when the funding constraints become more binding, the returns of BAB tend to decrease. They also find the beta is compressed toward one and the market sensitivity of BAB portfolio increases when funding liquidity risk is high. They also show that investors who are facing with more leverage and margin constraints tend to hold riskier assets in their portfolio.

However, FP does not study the direct linkage between the margin constraints and alpha. This provides a motivation for my study to fill this research gap. The special institutional setting of stock-specific margin constraints in China helps to examine the direct relationship between the margin constraints and alpha, which is not explored by FP in the U.S. market. Moreover, to my best knowledge, no study ever investigates the BAB investment strategy in China. By

conducting this study, it helps to realize whether the low-alpha phenomenon for high-beta securities is indeed driven by the margin constraints, and it also provides an insight of how the margin trading volume affects the security alpha. Besides, it also draws the investors' attention about profitability of BAB investment strategy in China.

3. Data and Methodology

3.1 Data

The data in this study are obtained from two sources. Stock return, market value, trading volume, risk-free rate and financial statements data[5] are acquired from the China Stock Market & Accounting Research (CSMAR). All the stocks that are available on CSMAR between July 1993 and June 2014 are included. Besides, the margin trading and short selling information, Consumer Price Index (CPI) as well as the Shanghai Interbank Offered Rate (SHIBOR) are obtained from Wind database. The margin trading and short selling data include margin trading volume, short selling volume, the date of the stocks that are eligible for margin trading and short selling. The sample period for the margin trading and short selling data covers from March 2010 to June 2014, while the sample period for CPI and SHIBOR is from Oct 2006 to June 2014. Since B-shares trading is not very active in China, I remove all the B-shares from the sample in my study. In order to reduce the influence of outliers, all the data are winsorized at bottom and top 1%.

When I estimate the rolling beta and alpha, I use daily data because the accuracy of estimation improves with the sample frequency (Merton, 1980). However, when I construct the

[5] The use of the financial statement data is based on the following rules:
(1) If the time-series data is before June, the previous two year financial statement data (t-2) is used.
(2) If the time-series data is after June, the previous one year financial statement data (t-1) is used.

betting against beta (BAB) portfolio, monthly data is used as the BAB portfolio is rebalanced monthly. Table 1 reports the basic sample statistics of the listed companies in China.

<Insert Table 1 here>

3.2 Methodology

3.2.1 Estimating the Ex-Ante Beta

Before constructing the BAB portfolio, I need to estimate the ex-ante beta of the stock and decide whether it belongs to high-beta or low-beta security. I follow the methodology of FP, the ex-ante beta of stocks is estimated from rolling regressions of excess returns on market excess returns. Basically, the ex-ante beta estimation is based on the following formula:

$$\hat{\beta}_i^{ts} = \hat{\rho}\frac{\hat{\sigma}_i}{\hat{\sigma}_m} \quad \text{.....(1)}$$

$\hat{\sigma}_i$ and $\hat{\sigma}_m$ are the estimated standard deviation of the stock i and the market, where $\hat{\rho}$ refers to the correlations between the stock i and the market. In order to improve the estimation accuracy, daily data are used in the ex-ante beta estimation. FP use one year rolling data to estimate for the standard deviation and five year rolling data to estimate for the correlation in U.S. market. Since the sample period is relatively short in China, it only lasts for around 20 years. If I use five year rolling data to account for the correlation, I would need to discard one-fourth of the time-series data. In order to make a good use of all the sample data, I estimate the standard deviation and the correlation by only using one year rolling data in calendar day basis. Following the methodology of FP, I use one-day log return to account for the standard deviation. For the purpose of controlling the nonsynchronous trading, I follow FP to use three-day log return, $r_{i,t}^{3d} =$

$\sum_{k=0}^{2} ln(1 + r_{t+k}^{i})$, to estimate the correlation. Besides, I set the minimum estimation window as 180 calendar days of non-missing data to estimate for the standard deviation as well as the correlation.

In order to avoid the influence of outliers, the estimated time-series beta is shrunken toward the cross-sectional mean of beta based on the following formula: [Vasicek (1973) and Elton, Gruber, Brown, and Goetzmann (2003)]

$$\hat{\beta}_i = w_i \hat{\beta}_i^{ts} + (1 - w_i)\hat{\beta}^{cs} \quad \text{.....(2)}$$

$\hat{\beta}_i^{ts}$ is the estimated time-series beta for stock i, $\hat{\beta}^{cs}$ is the cross-sectional mean of beta and it is set to be one. $w_i = 1 - \frac{\sigma_{i,ts}^2}{(\sigma_{i,ts}^2 + \sigma_{i,cs}^2)}$, where the numerator is the variance of the estimated time-series beta and the denominator is the sum of the variance of time-series beta and cross-sectional beta.

3.2.2 Investigating the Phenomenon of High-Beta Securities Associated with Low-Alpha

After obtaining the ex-ante beta for the stocks in each calendar month, I rank the stocks in ascending order based on the past one year ex-ante betas from rolling regression at the beginning of each calendar month. Stocks are assigned to decile portfolios by mainboard stocks breakpoints. The mainboard refers to the A shares in Shanghai Stock Exchange and Shenzhen Stock Exchange, excluding SME and GEM. This helps to determine whether the phenomenon of high-beta associated with low-alpha can be observed. For the purpose of simplicity, all the portfolios are equally-weighted. Besides, the standard capital asset pricing model (CAPM), Fama and French (1993) three-factor model and Carhart (1997) four-factor model are also studied.

3.2.3 Constructing the BAB Portfolio

In order to construct the BAB factor, all stocks are assigned to either low-beta or high-beta portfolio based on the past one year ex-ante betas from rolling regression. Basically, the ex-ante betas are ranked in acceding order first. If the ex-ante beta of a stock is lower (higher) than the average rank (the median of cross-sectional ex-ante beta), the stock is assigned to low-beta portfolio (high-beta portfolio). After distinguishing which group the securities belong to, the stock returns are weighted by the ranked beta (the more deviated from the average rank is, the heavier the weight is), where the lower-beta securities have higher weights in the low-beta portfolio and higher-beta securities have higher weights in the high-beta portfolio. In fact, this weighting setting helps to highlight the contribution of the extreme securities in terms of their beta (high or low) to the portfolio return (low-beta portfolio and high-beta portfolio). The portfolios are rebalanced at the beginning of each calendar month and are rescaled by using the technique of leveraging (low-beta portfolio) or deleveraging (high-beta portfolio), which ensures the low-beta and high-beta portfolio to have a beta of one at portfolio formation in order to maintain zero-beta BAB portfolio. In other words, the low-beta (high-beta) portfolio is leveraged (deleveraged) by the low-beta (high-beta) portfolio beta. The BAB factor is a zero-beta self-financing portfolio, which longs the low-beta portfolio and shorts the high-beta portfolio. I follow FP to construct the BAB factor by using the following formula:

$$r_{t+1}^{BAB} = \frac{1}{\beta_t^L}\left(r_{t+1}^L - r_f\right) - \frac{1}{\beta_t^H}\left(r_{t+1}^H - r_f\right) \quad \text{.....(3)}$$

For the low-beta portfolio (the first part of the equation), the portfolio return is obtained by $r_{t+1}^L = r_{t+1}' w_L$ and the portfolio excess return is leveraged by the portfolio beta $\beta_t^L = \beta_t' w_L$. For the high-beta portfolio (the second part of the equation), the portfolio return is calculated by

$r_{t+1}^{H} = r_{t+1}' w_H$ and the portfolio excess return is deleveraged by $\beta_t^H = \beta_t' w_H$. The portfolio weight for low-beta portfolio is $w_L = k(z - \bar{z})^-$, where the high-beta portfolio weight is $w_H = k(z - \bar{z})^+$. z is the rank of the ex-ante beta vector at portfolio formation and the average rank of ex-ante beta is obtained by $\bar{z} = \frac{1_n' z}{n}$. $1_n'$ is an *1 x n* vector of ones. k is the normalizing factor $k = \frac{2}{1_n' |z - \bar{z}|}$, which ensures the sum of portfolio weight is equal to one ($1_n' w_L = 1$ and $1_n' w_H = 1$). The "+" and "-" indicate the positive and negative elements in the vector. r_f is the risk-free rate.

For example, there are only four stocks in the sample at time t, namely stock A, B, C and D. In addition, the beta and the return of these stocks are 0.6, 0.8, 1.2, 1.4 and 8%, 6%, 5%, 4% respectively. Accordingly, the rank of the ex-ante beta for the securities is 1, 2, 3 and 4 respectively and average rank is 2.5 [(1+2+3+4)/4]. Therefore, the deviation between beta rank and average rank is -1.5, -0.5, 0.5 and 1.5 respectively. Based on this information, the low-beta portfolio is comprised of stock A and B, while the high-beta portfolio consists of stock C and D.

Moreover, normalizing factor (k) is calculated as 2 divided by the sum of absolute deviation between beta rank and average rank. The sum of absolute deviation is |-1.5|+|-0.5|+|0.5|+|1.5| = 4. Thus, k is 2/4 = 0.5. This value ensures the sum of the weights is equal to one. The portfolio weight is obtained by the product of the normalizing factor and the deviation.

For the low-beta portfolio, the weight of stock A is 0.75 (0.5 x 1.5), while the weight of stock B is 0.25 (0.5 x 0.5). For the high-beta portfolio, the weight of stock C is 0.25 (0.5 x 0.5), while the weight of stock D is 0.75 (0.5 x 1.5). The above shows that the low-beta securities have higher weight in low-beta portfolio, where the high-beta securities have higher weight in the

high-beta portfolio. After getting the weight for each security, the portfolio return and portfolio beta can be calculated accordingly.

For the portfolio return, the return of the low-beta portfolio (stock A and B) is equal to 7.50% (0.75 x 8% + 0.25 x 6%), while the return of the high-beta portfolio (stock C and D) is 4.25% (0.25 x 5% + 0.75 x 4%). For the portfolio beta, the beta of the low-beta portfolio (stock A and B) is 0.65 (0.75 x 0.6 + 0.25 x 0.8), where the beta of the high-beta portfolio (stock C and D) is 1.35 (0.25 x 1.2 + 0.75 x 1.4). Given the risk-free rate is equal to 2%, the excess return for low-beta and high-beta portfolio is 5.50% and 2.25% respectively.

In order to construct the zero-beta BAB portfolio (long the low-beta portfolio and short the high-beta portfolio at the same time), the low-beta portfolio return is leveraged by its associated beta and the high-beta portfolio return is deleveraged by its associated beta. The leverage factor (rescale factor) for low-beta portfolio is 1.54 (1/0.65), where the deleverage factor (rescale factor) for high-beta portfolio is 0.74 (1/1.35). Finally, BAB return is obtained and it should be equal to 6.79% (1.54 x 5.50% - 0.74 x 2.25%).

3.2.4 Estimating the Effects of Firm-Specific Margin Constraints to Alpha

China lifted the bans on margin trading and short selling in March 2010. I am interested in investigating how the alpha is influenced through its associated beta by this special institutional setting. To estimate the effects of firm-specific margin constraints to alpha, I obtain the ex-ante alpha and beta of stocks from rolling regressions of excess returns on market excess returns. The difference-in-difference (DID) regression can be constructed as following:

$$\hat{\alpha}_{i,t} = \delta_0 + \delta_1 List_i + \delta_2 D_{t-1} + \delta_3 (List_i * D_{t-1}) + \theta_0 \hat{\beta}_{i,t-1} + \theta_1 \left(\hat{\beta}_{i,t-1} * List_i\right) +$$

$$\theta_2 \left(\hat{\beta}_{i,t-1} * D_{t-1}\right) + \theta_3 \left(\hat{\beta}_{i,t-1} * List_i * D_{t-1}\right) + \varepsilon_{i,t} \text{.....(4)}$$

$List_i$ is set to one if the securities are eligible for margin trading and short selling. If the sample period is after March 31, 2010, D_t is equal to one. $\hat{\alpha}_{i,t}$ and $\hat{\beta}_{i,t}$ are the ex-ante alpha and beta of stocks from rolling regressions respectively.

3.2.5 How the Margin Trading Volume Affects the Alpha

In my study, I also would like to know whether the margin trading volume influences the securities' alpha through its beta. To estimate the effects, I run the following fixed effect regression:

$$\hat{\alpha}_{i,t} = \sum_i D_i^{FE} + \delta_1 \hat{\beta}_{i,t-1} + \delta_2 \left(\hat{\beta}_{i,t-1} * D_{t-1}^{Margin\_H}\right) + \varepsilon_{i,t} \text{.....(5)}$$

$D_{t-1}^{Margin\_H}$ measures the degree of margin trading level under the condition that margin trading and short selling are allowed (after March 2010) and given the stocks that are on the list for margin trading and short selling. Margin trading level is defined as the past 12 months rolling sum of the margin trading amounts divided by year-end tradable/negotiable market value6. In each calendar month, the average margin trading level is obtained. If the margin trading level is above the average margin trading level, $D_{t-1}^{Margin\_H}$ will be assigned to 1, 0 otherwise. Moreover, D_i^{FE} is the fixed-effect dummy.

[6] As there is a big time gap between the end of fiscal year and the release date of annual reports, I make some adjustments for the year-end tradable/negotiable market value. For the time-series rolling data, if the calendar month is before June, I use the previous two year year-end tradable/negotiable market value. On the other hand, if the calendar month is after June, I use the previous one year year-end data.

I also add the short selling level as a control variable in order to make the test more robust. The regression is very similar to the above formula:

$$\hat{\alpha}_{i,t} = \sum_i D_i^{FE} + \delta_1 \hat{\beta}_{i,t-1} + \delta_2 \left(\hat{\beta}_{i,t-1} * D_{t-1}^{Margin\_H}\right) + \delta_3 \left(\hat{\beta}_{i,t-1} * D_{t-1}^{Short\_H}\right) + \varepsilon_{i,t} \ldots\ldots (6)$$

$D_{t-1}^{Short\_H}$ is the short selling level dummy and definition is the same as the margin trading level dummy.

3.2.6 The Effect of Funding Constraints to BAB Return

In order to construct BAB portfolio, the investors are required to borrow and lend at risk-free rate, and to use the technique of leveraging or deleveraging in order to maintain a market-neutral BAB portfolio. I would like to test how the BAB returns are influenced by the funding constraints. I follow FP to construct the test by running this regression:

$$\hat{r}_t^{BAB} = \delta_0 + \delta_1 FCS_{t-1} + \delta_2 \Delta FCS_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

$\hat{r}_t^{BAB}$ is the time series BAB returns. FCS_{t-1} is the funding constraints (FC) spread lagged by one month, which is measured by the difference between Shanghai Interbank Offered Rate (SHIBOR) and the risk-free rate. ΔFCS_t is defined as the FC spread at the end of month *t* minus FC spread at the end of month *t-1*.

In order to have a more robust result, I add a series control variables to the original regression as following:

$$\hat{r}_t^{BAB} = \delta_0 + \delta_1 FCS_{t-1} + \delta_2 \Delta FCS_t + \delta_3 BetaS_t + \delta_4 r_{t-1}^{BAB} + \delta_5 Inflation_{t-1} + \delta_6 r_{t-1}^{Mkt} + \varepsilon_t \ldots (8)$$

$BetaS_t$ is defined as beta spread $(\beta_t^H - \beta_t^L)/(\beta_t^H * \beta_t^L)$, where β_t^H (β_t^L) is the beta of the short (long) component of BAB portfolio at the portfolio formation. $r_{t-1}^{BAB}$is the BAB return lagged by one month. $Inflation_{t-1}$ is equal to one-year China Consumer Price Index inflation rate, lagged one month. r_{t-1}^{Mkt} is the monthly return of the Chinese market portfolio (B-shares are excluded and the return is value-weighted), lagged one month.

3.2.7 Beta Compression

FP model suggests that the securities' beta is compressed toward one and the market sensitivity of BAB portfolio increases when funding liquidity risk is high. I would like to know whether this phenomenon exists in China. I follow their methods to construct the test. Basically, the test can be divided into two parts. First, I examine the cross-sectional dispersion of beta when the funding liquidity risk varies. Second, I calculate the conditional market beta under different credit condition. In these two tests, I use the volatility of FC spread as a proxy to measure the funding liquidity risk. In fact, the volatility of FC spread in month t is defined as $\sigma_t^{FCS} = \sqrt{\sum_{d \in month\ t} (\Delta FCS_d - \overline{\Delta FCS_t})^2}$, where d denotes the number of days in month t. FC spread volatility is ranked in ascending order and is assigned into three groups (low, medium and high) based on the full sample breakpoints.

To estimate the cross-sectional dispersion of beta, I run the following regression:

$$\widehat{Dispersion_t} = \delta_1 D_t^{Low} + \delta_2 D_t^{Medium} + \delta_3 D_t^{High} + \varepsilon_t \quad \text{.....(9)}$$

$\widehat{Dispersion}$ is the dispersion measurements, which are standard deviation, mean absolute deviation and interquintile range. The dummy variables represent the funding liquidity condition.

For estimating the conditional market beta, I run the following three regressions:

$$\hat{r}_t^{BAB} = \alpha + \beta_1\left(r_t^{MktEx} D_t^{Low}\right) + \beta_2\left(r_t^{MktEx} D_t^{Medium}\right) + \beta_3\left(r_t^{MktEx} D_t^{High}\right) + \varepsilon_t \ldots\ldots(10)$$

$$\hat{r}_t^{BAB} = \alpha + \beta_1\left(r_t^{MktEx} D_t^{Low}\right) + \beta_2\left(r_t^{MktEx} D_t^{Medium}\right) + \beta_3\left(r_t^{MktEx} D_t^{High}\right) + \beta_4 SMB_t + \beta_5 HML_t + \varepsilon_t \ldots\ldots(11)$$

$$\hat{r}_t^{BAB} = \alpha + \beta_1\left(r_t^{MktEx} D_t^{Low}\right) + \beta_2\left(r_t^{MktEx} D_t^{Medium}\right) + \beta_3\left(r_t^{MktEx} D_t^{High}\right) + \beta_4 SMB_t + \beta_5 HML_t + \beta_6 MOM_t + \varepsilon_t \ldots\ldots(12)$$

$\hat{r}_t^{BAB}$ represents the time-series return. α is the intercept of these three regression. SMB_t and HML_t are the size and book to market factor. MOM_t is the momentum factor. The dummy variables represent the funding liquidity risk.

4. Return Pattern Sorted by Beta and the Performance of BAB Portfolio

4.1 Return Patten Sorted by Beta

In order to observe if the phenomenon of high-beta associated with low-alpha exists in Chinese stock market, I do the followings. Firstly, I obtained the ex-ante beta from the rolling regression based on formula (1) and (2). Secondly, I rank the stocks in ascending order based on the past one year ex-ante betas at the beginning of each calendar month and assign the stocks to one of ten decile portfolios. Finally, I calculate the average return, alpha, volatility and Sharp ratio in each decile portfolio. This helps to observe the return pattern sorted by beta. Since the returns are at portfolio level, the firm-specific return variation (noise) can be diversified away, which makes the results more convincing. Table 2 reports the beta-sorted calendar-time portfolio returns for Chinese stock market from July 1994 to June 2014. As the primary reason of the test

is to study whether the phenomenon of high-beta associated with low-alpha exists in China, the portfolios are equally-weighted for simplicity.

<Insert Table 2 here>

This table shows the excess return decreases as beta increases. The excess return in portfolio 1 (low-beta) is 1.24%, while it decreases to 1.10% in portfolio 10 (high-beta). Even when controlling for CAPM, Fama and French (1993) three-factor and Charhart (1997) momentum factor, the results show the similar conclusion. CAPM alpha decreases from 0.51% to 0.17%, three-factor alpha declines from 0.43% to -0.26% and four-factor alpha drops from 0.41% to -0.27%. Moreover, Sharpe ratio also declines as beta goes up, which decreases from 0.48 to 0.34. Although the excess return, alpha and Sharpe ratio do not decline monotonically, almost all the significant returns appear in portfolio 1 to portfolio 5, while the negative returns appear in portfolio 6 to portfolio 10. In fact, this phenomenon provides a motivation of my further study. Is it possible for the investors to exploit the profits by buying the portfolio from 1 to 5 (low-beta securities) and selling the portfolio from 6 to10 (high-beta securities)?

4.2 BAB Return

After observing the return pattern, I am interested in whether the betting against beta (BAB) investment strategy of buying the low-beta securities and selling the high-beta security can generate significantly positive return. In order to test the performance of BAB investment strategy, I construct the BAB portfolio by using formula (3). Firstly, I assign the stocks to either low-beta or high-beta portfolio based on the past one year ex-ante beta from rolling regression. For example, if the ex-ante beta of a stock is lower (higher) than the median of cross-sectional

ex-ante beta, the stock is assigned to low-beta portfolio (high-beta portfolio). Secondly, stocks returns are weighted by the ranked betas, where the lower-beta securities have larger weights in the low-beta portfolio and higher-beta securities have larger weights in the high-beta portfolio. Thirdly, the low-beta (high-beta) portfolio return is leveraged (deleveraged) by its associated beta. Finally, the low-beta and high-beta portfolios are rebalanced at the beginning of each calendar month and are rescaled to have a beta of one at portfolio formation in order to maintain zero-beta BAB portfolio. The BAB factor is a zero-beta (market-neutral) self-financing portfolio, which longs the low-beta portfolio and shorts the high-beta portfolio. Table 3 presents the portfolio performance and the characteristic.

<Insert Table 3 here>

In Panel A, the performance of low-beta, high-beta and BAB are reported in the first, second and third column respectively. The third column shows the BAB portfolio produces significantly positive excess return of 0.44% (t-statistics=2.02). When controlling for the CAPM, the alpha of BAB portfolio is 0.35% (t-statistics=1.90) and it is significant at 10% level. However, the three-factor alpha and four-factor alpha of BAB portfolio are 0.51% (t-statistics=3.01) and 0.51% (t-statistics=2.91) respectively, and they both are significant at 1% level. China only lifted the ban on margin trading and short selling in March 2010, but the BAB investment strategy requires the short selling of the high-beta assets. Therefore, I am afraid that the BAB return is mainly driven by the short-side of the high-beta securities. Fortunately, by comparing the return of low-beta and high-beta portfolio, the BAB portfolio return indeed primarily comes from the long-side of low-beta portfolio but not the short-side of high-beta portfolio. In fact, this proves BAB investment strategy works in China.

In Panel B, a series of portfolio characteristics are presented, such as return on asset (ROA), earnings before interest and tax margin (EBIT margin), P/E ratio, turnover ratio, total market value (size), book-to-market (BM ratio), past 12 months return and Aminhud ratio. In terms of the profitability measurements, ROA and EBIT margin of low-beta portfolio are higher than high-beta portfolio. This not only indicates the low-beta firms actually utilize the assets better than the high-beta firms, but also shows the operating expenses of low-beta firms are less than the high-beta firms that lead to more profitable organizations. Moreover, P/E and BM ratio of low-beta portfolio are higher than high-beta portfolio, which shows the firms in low-beta portfolio may be the growth firms. By observing the turnover ratio, the liquidity of low-beta firms is better than the high-beta firms. In addition, Amihud ratio shows that the price impact (the change of the price) of low-beta portfolio is higher than high-beta portfolio given the same amount of capital (trading volume). The past 12 months return shows the momentum effect of low-beta portfolio is stronger than high-beta portfolio. Besides, the size of low-beta firms is bigger than high-beta firms, which indicates the BAB return may not be paper return as the BAB return mainly comes from the big firm and long-side portfolio. However, it is better to sort the BAB return by firm size to further investigate how the performance of BAB investment strategy changes as the firm size varies. (This test is constructed in the next section)

After realizing BAB portfolio indeed can produce significant return, I would like to know how the BAB return varies across different period of time. In order to study how the BAB return behaves, I plot the time series of cumulative returns for monthly rebalancing portfolio from July 1994 to June 2014 in Figure 1.

<Insert Figure 1 here>

In fact, there are two observations in this figure that I need to emphasize. Firstly, this figure clearly shows the cumulative return of market-neutral BAB portfolio does not fluctuate a lot, which increases up to 150% stably throughout the sample period. Even when the internet bubble burst in 2000, the BAB return did not drop significantly. Although the BAB return was affected during the sub-prime mortgage crisis in 2008, the magnitude was relatively small. Secondly, this figure demonstrates the low-beta portfolio outperforms high-beta portfolio in most of the time. This indicates the BAB investment strategy of buying the low-beta portfolio and selling the high-beta portfolio can help to generate superior profits.

5. Robustness Tests

5.1 BAB Return Sorted by Size

It is not good if the BAB investment strategy only works in small firms because the return is very likely to be paper return that may easily vanish in big firms. In order to test whether the BAB investment strategy is effective for big firms, I sort the firm size (total market value) in ascending order and divide it into five groups to observe the BAB return pattern. Table 4 reports the performance of BAB investment strategy sorted by the firm size.

<Insert Table 4 here>

Basically, there are two major observations in this table. First, the small firm outperforms the big firm regardless of the low-beta portfolio or the high-beta portfolio, which is consistent with the robust findings of the size effect in China. Second, it shows the low-beta portfolio outperforms high-beta portfolio regardless of the firm size, but the BAB portfolio actually works better in big firms. In portfolio 5 (big-firm), the BAB investment strategy produces a monthly

significant return of 0.51% (t-statistics=1.80). When controlling CAPM, three-factor and four-factor, the alphas are 0.47% (t-statistics=1.74), 0.72% (t-statistics=2.75) and 0.70% (t-statistics=2.55) respectively and all of them are statistically significant (at least at 10% level). However, the performance of BAB investment strategy is weak in portfolio 1 (small firms). Although, the BAB investment strategy generates monthly positive excess return of 0.21% (t-statistics=0.77), it is not statistically significant. The conclusion remains the same for the small firm even when control for the CAPM, three-factor and four-factor model. In fact, the performance of the BAB portfolio improves as the firm size increases.

Although the BAB investment strategy does not work in small firms, this is not my concerns. Even if it performs well in small firms, the return may easily disappear after taking into account of the transaction costs and eligibility for short selling (small firms are less likely to be in the designated list). The primary reason of this test is to make sure the BAB investment strategy can produce significantly positive return in big firms. Besides, the realized beta (0.06) is almost the same as the ex-ante beta (0.00) in portfolio 5 (big-firms). This indicates the market-neutral characteristic of BAB investment strategy in big firms is indeed stronger than small firms.

5.2 Quintile Strategy of BAB

The original BAB investment strategy suggests buying all the low-beta securities and selling all the high-beta securities, which is costly and time consuming especially when the investors need to rebalance the portfolio monthly. The number of securities that needed to be traded to construct the BAB portfolio varies from 176 to 2456 over the past 20 years[7]. In fact, it

[7] Please refer to table 1 for basic sample statistics.

is less costly and time consuming if the investors only buy the bottom 20% of low-beta securities and short the top 20% of high-beta securities. Table 5 reports the quintile strategy for BAB portfolio. At the beginning of each calendar month, stocks are ranked in ascending order based on the past one year ex-ante betas from rolling regression. The ranked stocks are assigned to quintiles portfolios by the mainboard stocks breakpoints. All the stocks are beta-weighted in each portfolio. In this table, panel A presents the performance of the quintile BAB investment strategy, while the quintile BAB portfolio characteristics are reported in panel B.

<Insert Table 5 here>

Panel A shows quintile BAB portfolio generates a significant monthly excess return of 0.52% (t-statistics=1.83). CAPM alpha is 0.41% (t-statistics=1.67), which is marginally significant at 10%. However, the three-factor alpha is 0.60% (t-statistics=2.68) and four-factor alpha is 0.59% (t-statistics=2.55), and they are both significant at 1% and 5% level respectively. From this quintile strategy, I notice that most of the BAB return also comes from the long-side of low-beta portfolio but not the short-side of high-beta portfolio. In fact, this phenomenon can also be observed if the investors long all the low-beta securities and short all the high-beta securities[8].

Panel B shows the portfolio characteristics of quintile strategy are actually quite similar to longing/shorting all the securities. ROA and EBIT margin are higher in portfolio 1 (low-beta), which indicates the profitability is better for low-beta firms. Moreover, the P/E and BM ratio of portfolio 1 (low-beta) are also higher than portfolio 5 (high-beta). This once again suggests the firms in portfolio 1 (low-beta) are very likely to have potential to grow. Besides, the liquidity risk is lower in portfolio 1 (low-beta) as the turnover ratio is slightly higher than portfolio 5 (high-beta). The size (total market value) suggests the firms in portfolio 1 (low-beta) are indeed

[8] Please refer to table 3 for more details.

big firms, while the firms size in portfolio 5 (high-beta) are relatively small. The momentum effect is also stronger for low-beta portfolio. The Amihud ratio suggests the price impact is bigger in portfolio 1 (low-beta).

Despite I change the original BAB investment strategy to quintile strategy, the BAB portfolio performance and the characteristics are actually very similar. However, the number of securities required to construct the BAB portfolio decreases by 60%. Quintile BAB investment strategy only requires to trade 70 stocks in 1993 and 982 stocks in 2014. This not only helps to save the transaction cost, but also the time. In a globalized world that is full of competition, if the investors are not fast enough to construct and rebalance their portfolio, the arbitrage opportunity may run away in a second.

5.3 Decile Strategy of BAB

From the above previous analysis, quintile BAB investment strategy does help the investors to earn some profits and save the transaction cost as well as the time. However, the number of listed companies keeps increasing each year. In Chinese exchange, there are around 2456 listed companies in 2014 and this number is very likely to increase each year. Therefore, although quintile strategy helps to decrease the number of securities required for constructing the BAB portfolio, its effectiveness in terms of time saving and reducing the transaction cost may diminish in the future. For this reason, I would like to construct the BAB portfolio by using decile strategy. Table 6 shows the decile strategy for BAB portfolio. In this table, panel A presents the performance of the decile BAB investment strategy, while the decile BAB portfolio characteristics are reported in panel B.

<Insert Table 6 here>

Panel A shows the return in portfolio 1 (low-beta) is indeed higher than the return in portfolio 10 (high-beta). The decile BAB investment strategy produces a monthly excess return of 0.57% (t-statistics=1.58) and CAPM alpha is 0.44% (t-statistics=1.40). However, the excess return and CAPM alpha are not statistically significant. Fortunately, three-factor alpha and four factor alpha are significant at 5% level, and they are equal to 0.68% (t-statistics=2.43) and 0.68% (t-statistics=2.34) respectively. By comparing the return in portfolio 1 (low-beta) and portfolio 10 (high-beta), most of the decile BAB return is also generated by the long-side of low-beta portfolio rather than the short-side of high-beta portfolio. This phenomenon appears in the original BAB investment strategy (buying and selling all the securities) and quintile BAB investment strategy. This provides a strong evidence to show that BAB return still can be observed even short selling is not allowed in China before March 2010.

Panel B shows the profitability of portfolio 1 (low-beta) is better than that of portfolio 10 (high-beta) as the ROA and EBIT margin are both higher in portfolio 1 (low-beta). P/E and BM ratio also suggest that the growth potential of firms in portfolio 1 (low-beta) is actually higher. The turnover ratio is higher in portfolio 1 (low-beta), which implies the firms in this portfolio are more liquid. The price impact is also stronger in portfolio 1 (low-beta) by observing the Amihud ratio. Moreover, the momentum effect in portfolio 1 (low-beta) is almost two times higher than the effect in portfolio 10 (high-beta). Besides, the size (total market value) shows the securities in long-side low-beta portfolio are the big firms, which is around three times higher than the size in short-side high-beta portfolio.

The decile BAB strategy only requires investors to long the bottom 10% low-beta firms and short the top 10% high-beta firms, which can help to save more transaction cost and time.

However, the performance of this decile strategy is controversial. Although the number of securities required constructing the BAB portfolio decreases significantly by 80%, the excess return of BAB portfolio and CAPM alpha are not statistically significant. Fortunately, the alpha is significant when controlling for three-factors or four-factors. This suggests that the investors may need to take a balance of the cost involves when constructing the portfolio as well as the overall performance of the portfolio.

5.4 Controlling for January Effect

In order to reduce the taxable gains, retail investors tend to realize the losses in December and buy back the securities in January. Besides, institutional investors incline to sell the losers in December as they are unwilling to report too many loses in their portfolios at the year-end. Later on, they repurchase these securities after the reporting date in January, which is called as window dressing. In fact, avoiding to pay more taxes and window dressing cause the return of securities higher in January simply due to the buying pressure. These common calendar anomalies should be considered when the performance of the BAB investment strategy is examined. Table 7 reports the BAB return when controlling for January effect.

<Insert Table 7 here>

Table 7 shows the effectiveness of BAB investment strategy can still be maintained even when January returns are excluded. The BAB investment strategy brings a significantly positive return of 0.51% (t-statistics=2.18). Moreover, CAPM alpha is 0.42% (t-statistics=2.11) and it is significant at 5% level. While three-factor alpha and four-factor alpha are equal to 0.57% (t-

statistics=3.10) and 0.57% (t-statistics=3.04) respectively, and they are both significant at 1% level.

Even when I exclude all the January returns, the BAB portfolio can still produce significant return. This shows the BAB return is robust, which is not affected by the January effect.

5.5 Sub-Period Test for the Split Share Reform

The Chinese central government launched a plan for split share reform in the summer of 2005. The plan intends to increase the tradable shares (circulating shares). Basically, the total shares of a firm equal to the sum of tradable shares and non-tradable shares. Non-tradable shares are owned by the government or majority shareholders, which are not allowed to trade to the public in the financial market. By increasing the number of tradable shares in the market, more shares can be circulated and the market efficiency can be improved. Table 8 reports the sub-period test for BAB investment strategy. The sample period is divided into two groups. The first group is before the Chinese split share reform, from July 1994 to June 2005. The second group is after the Chinese split share reform, from July 2005 to June 2014.

<Insert Table 8 here>

This table shows the performance of BAB investment is weak before the split share reform in 2005. The excess return, CAPM alpha and three-factor alpha are 0.20% (t-statistics=0.64), 0.16% (t-statistics=0.57) and 0.43% (t-statistics=1.64) respectively. However, they are all statistically insignificant. Four-factor alpha is 0.44% (t-statistics=1.67), which is marginally significant at 10% level. On the contrary, the performance of BAB investment

strategy is considerably good after the reform. It produces a monthly significant excess return of 0.73% (t-statistics=2.62). Besides, CAPM alpha is 0.58% (t-statistics=2.55), three-factor alpha is 0.53% (t-statistics=2.49) and four-factor alpha is 0.48% (t-statistics=2.30). They are all significant at 5% level.

Why the BAB portfolio does not generate significant return before Chinese split share reform? One of the possible explanations is the inefficiency regards of non-tradable shares, which somehow prevents the constrained investors to bid up the high-beta securities. In other words, constrained investors may not be able to overweight the high-beta securities and they may tend to hold a fair weight of low-beta and high-beta securities when constructing the portfolios. For this reason, BAB investment strategy does not perform well before the Chinese split share reform. FP model claims the existence of BAB returns is due to constrained investor to bid up the high-beta securities, which causes the high-beta securities to have lower return. After the reform, more non-tradable shares become tradable shares. The constrained investors face fewer obstacles when constructing the portfolios and they are easier to bid up the high-beta securities. Thus, BAB return can be observed after the reform.

5.6 BAB Portfolio Monthly and Cumulative Return: Monthly Rebalancing

In this section, I examine the return of BAB portfolio after the portfolio is formed. Basically, I track the performance of BAB investment strategy up to 36 months following the portfolio formation date. The reason of establishing this test is to answer two questions. First, when is the optimal holding period for BAB portfolio? Second, does the reverse phenomenon occur in BAB investment strategy? Table 9 reports the average returns of monthly rebalancing

BAB portfolio by different holding period. The BAB portfolio formation starts at the end of each month.

<Insert Table 9 here>

Table 9 shows almost all the monthly BAB returns are significantly positive for the first two years following the portfolio formation date. Although the monthly BAB returns are still significant in the second year after the portfolio formation, the magnitude of return tends to drop. The first insignificant return occurs in the twenty-fourth after the BAB portfolio is formed. In the third year, all the monthly BAB returns are statistically insignificant even the returns are still positive. By observing the monthly BAB returns pattern, the maximum average monthly BAB return occurs at the fourth month following the portfolio formation date, which is equal to 0.79% (t-statistics=3.51) and significant at 1% level. As all the month BAB returns are positive regardless of the event time after the portfolio formation date, all the cumulative returns are significantly positive. However, it increases in a decreasing rate because the monthly BAB returns starts to decline at the fourth month following the portfolio formation date.

In terms of a monthly rebalancing BAB investment strategy, investors should realize that BAB portfolio generates the maximum return at the fourth month after the portfolio is formed. Even though the cumulative return keeps increasing, the magnitude of the BAB return or the attractiveness of BAB investment strategy decreases. I suggest the investors at least hold the portfolio for four months after the portfolio is formed in order to absorb the highest monthly BAB return. Moreover, investors should not hold the portfolio for too long as the monthly BAB returns decrease significantly in the second year following the portfolio formation date. Therefore, I recommend the investors at most to hold the BAB portfolio for 23 months as the

insignificant monthly returns start to take place in the twenty-fourth after the portfolio formation. They should close the position and realize the BAB return before the insignificant returns occur.

In order to study the return pattern of monthly rebalancing BAB portfolio after the portfolio is formed, I plot the BAB monthly return and cumulative return in Figure 3. The time interval following the portfolio formation date varies from 1 month to 36 months. The portfolios are rebalanced at the beginning of each calendar month. The sample period is from July 1994 to June 2014.

<Insert Figure 3 here>

Figure 3 shows all the returns of monthly rebalancing BAB portfolio are positive. However, the returns keep declining after the appearance of the maximum return in the fourth month following the portfolio formation date. As a result, the cumulative return of BAB portfolio increases much more slowly afterwards.

5.7 Annual Rebalanced BAB Portfolio

The original BAB investment strategy suggests the investors to rebalance the portfolio monthly. Monthly rebalancing is good in the sense that the information can be updated timely, but it is costly especially when there are large numbers of securities in the portfolio. By reducing the rebalancing frequency, the cost of managing the portfolio can be shrunk. However, the performance of the BAB portfolio may be affected as the information is updated more slowly. Table 10 reports the results of changing the rebalancing frequency from monthly to annual. The BAB portfolios are rebalanced at the end of June each year rather than at the beginning of each calendar month.

<Insert Table 10 here>

In this table, annual rebalanced BAB portfolio brings around an annualized significant return of 6.12% (t-statistics=2.41). CAPM alpha is 3.96% (t-statistics=2.42), which is significant at 5% level. Three-factor alpha and four-factor alpha are equal to 4.99% (t-statistics=2.96) and 5.98% (t-statistics=3.10) respectively, and both are significant at 1% level. However, the discrepancy of ex-ante beta and realized beta for high-beta portfolio is large, which causes the realized beta of BAB portfolio deviates from zero by 0.20. As BAB portfolio is a market-neutral portfolio, the effectiveness of market-neutral is superior when the realized beta approaches to zero.

The BAB portfolio can produce significant return even when the rebalancing frequency changes from monthly to annual. However, the effectiveness of market-neutral is affected. The realized beta of annually rebalancing BAB portfolio is 0.20, which means that the BAB return is somehow positively related to the market return. Although the magnitude is still small, the investors should notice the "side-effect" of reducing the rebalancing frequency. There is no free lunch in this competitive financial market. If the investors want to save the portfolio management cost by extending the time of reviewing their portfolio to update the new information, they may need to take more market risk.

In order to show how the effectiveness of market-neutral is affected, I plot the time series of cumulative returns for annual rebalancing portfolio from July 1994 to June 2014 in Figure 2.

<Insert Figure 2 here>

This figure also shows the annual rebalancing BAB portfolio produces positive return in most of the time. The cumulative return of BAB portfolio increases to around 200% in 20 years.

However, the return volatility of annual rebalancing BAB portfolio is slightly higher than the monthly rebalancing one. This observation is consistent with the finding regards of the higher realized beta in table 10. Moreover, the low-beta portfolio also outperforms high-beta portfolio even when the rebalancing frequency changes from monthly to annual.

5.8 BAB Portfolio Monthly and Cumulative Return: Annual Rebalancing

As mentioned before, monthly rebalancing requires investors to pay more efforts. Therefore, I would like to track the performance of annual rebalancing BAB portfolio for 36 months after the portfolio formation date as well. Although the methodology is the same as monthly rebalancing, the results may have a big difference as the market information is updated annually. Table 11 presents the average returns of annual rebalancing BAB portfolio by different holding period. The BAB portfolio formation starts at the end of June each year

<Insert Table 11 here>

In table 11, almost all the monthly returns are insignificant and even negative returns can be observed. The annual rebalancing BAB portfolio generates maximum monthly return of 1.54% (t-statistics=2.45) in the tenth month following the portfolio formation date, which is significant at 5% level. In fact, there are only two monthly returns that are statistically significant. Even the cumulative return keeps increasing on average in long-term, the speed of increasing is much slower than the monthly rebalancing BAB portfolio as negative returns occurs.

From the above analysis, the performance of annual rebalancing BAB portfolio is not good as monthly rebalancing portfolio because most of the monthly BAB returns are not significant. Actually, this can be considered as the trade-off of annual rebalancing portfolio. The

returns can be affected greatly if the investors do not update the market information timely. However, there are some investors who are very busy and do not have time to rebalance their portfolio monthly. Therefore, if the investors decide to rebalance their BAB portfolio annually, I suggest them to hold the annual rebalancing BAB portfolio exactly for 10 months because the highest monthly return happens in the tenth month after the portfolio formation and almost all the monthly returns are statistically insignificant afterward.

Figure 4 plots the BAB monthly return and cumulative return for the purpose of observing the return pattern of annual rebalancing BAB portfolio after the portfolio formation. The time interval following the portfolio formation date varies from 1 month to 36 months. The portfolios are rebalanced at the end of June each year. The sample period is from July 1994 to June 2014.

<Insert Figure 4 here>

Figure 4 shows not all the BAB returns are positive and the cumulative return does not increase smoothly due to the present of negative BAB returns. The highest BAB return occurs in the tenth month following the portfolio formation date. Comparing the results with figure 3, the performance of monthly rebalancing BAB portfolio is much better than the annual rebalancing one.

6. Chinese Specific Tests

6.1 The Effect of Margin Constraints to Alpha

China lifted the bans on margin trading and short selling in March 2010. I am interested in investigating how the alpha is influenced through its associated beta by this special

institutional setting. FP model claims the constrained investors tend to overweight the high-beta securities, which causes its alpha lower in U.S. market. They explain the phenomenon of high-beta securities with low-alpha based on the individual-specific margin constraints. Moreover, they show that the people who hold low-beta securities are institutional investors, while the mutual fund and pension fund managers tend to hold high-beta securities. As there are leverage restrictions for mutual fund and pension fund in U.S. market, it is not surprised to know the portfolio beta for mutual fund and pension fund are higher. However, China does not have this kind of leverage restriction on mutual fund and pension fund. For this reason, it may not be possible to explain the phenomenon of high-beta securities associated with low-alpha through the individual-specific margin constraints in China. Therefore, I try to explain this phenomenon based on the stock-specific margin constraints in China. Table 12 reports the effect of stocks-specific margin constraints to alpha.

<Insert Table 12 here>

This table reports how the beta affects alpha under the margin constraints condition. Alphas and betas are calculated by the rolling regression (CAPM) based on the past one year daily data. The dependent variable is the rolling alphas (in percentage). The explanatory variables are the rolling betas and a series of interaction dummies variables with rolling betas. Lagged_TS_dummy is the time-series dummy, lagged by one month. As China market lifted the bans on margin trading and short selling in March 2010, lagged_TS_dummy will be assigned to 1 after that date, lagged by one month, 0 otherwise. list_dummy is the cross-sectional dummy for stocks. By using June 2014 as the breakpoint, list_dummy is equal to 1 (0) if the stocks that are allowed (not allowed) for margin trading and short selling. Indeed, if list_dummy is equal to 1 (0), it is considered as treatment group (control group). Margin_HL_dummy (short_HL_dummy)

measures the degree of margin trading (short selling) level under the condition that margin trading and short selling are allowed (after March 2010) and given the stocks that are on the list for margin trading and short selling. Margin trading (short selling) level is defined as the past 12 months rolling sum of the margin trading (short selling) amounts divided by year-end tradable/negotiable market value. In each calendar month, the average margin trading (short selling) level is obtained. If the margin trading (short selling) level is above the average margin trading level, margin_HL_dummy (short_HL_dummy) will be assigned to 1, 0 otherwise. Regression 1 is the difference in difference regression, where the data run from July 1994 to June 2014. Regression 2 and 3 are the stock fixed effect regression, where the data run from March 2010 to June 20149. Only the stocks that are allowed for margin trading and short selling are considered as sample in regression 2 and 3.

In difference-in-difference (DID) regression 1, only four coefficients have economic meanings. They are intercept, the interaction between the list dummy and the lagged time series dummy (list_dummy* lagged_TS_dummy), lagged beta as well as the interaction between lagged beta, the list dummy and the lagged time series dummy (lagged_beta*list_dummy* lagged_TS_dummy). The coefficient of list_dummy*lagged_TS_dummy is -0.0259 (t-statistics=-4.59), which is significant at 1% level. This means after the bans on margin trading and short selling were lifted and given the securities that are on the designed list, the alpha tends to drop. This suggests the short selling effects may dominate the margin trading effects in China, which is consistent with the findings from Sharif, Anderson and Marshall (2014). However, the initial propose of this test is to investigate how the alpha changes through its associated beta given the bans on margin trading and short selling were eliminated. Therefore, we should focus

[9] Please refer to section 4 for the regression.

on the relationship of the beta and the beta interaction with the times-series dummy and cross-sectional dummy. Regression 1 shows the negative relationship between the lagged beta and alpha, which is consistent with my previous findings that high-beta securities have lower alpha. The coefficient of lagged beta is -0.0385 (t-statistics=-21.28), which is significant at 1% level. The coefficient of lagged_beta*list_dummy*lagged_TS_dummy is 0.0237 (t-statistics=4.88) and it is also significant at 1%. In fact, this suggests the phenomenon of high-beta securities associated with low-alpha can be mitigated after the bans of margin trading and short selling were removed and given the securities that are on the designated list. Therefore, investors may no longer using BAB portfolios to generate superior profit as the stock-specific margin constraints become less binding. Regression 2 and 3 provide stronger evidences on this breakthrough. Only the securities that are eligible for margin trading and short selling will be considered as sample data for regression 2 and 3.

Regression 2 shows the coefficient of lagged beta is 0.0458 (t-statistics=5.05), which is significant at 1%. This confirms that the phenomenon of high-beta securities associated with low-alpha disappears once the stock-specific margin constraints are removed. Alternatively speaking, investors may not overweight the high-beta securities and thus lowering the alpha. Therefore, the return of high-beta securities is not squeezed down. Moreover, the coefficient of lagged_beta*margin_HL_dummy is 0.0187 (t-statistics=6.68) and it is significant at 1% level, which suggests margin trading level brings a positive impact to alpha through beta.

Regression 3 also presents similar results as regression 2 after adding a control variable of short selling level. In this regression, the coefficients sign of lagged beta and lagged_beta*margin_HL_dummy are still significantly positive. Besides, the coefficient of lagged_beta*short_HL_dummy is 0.0023 (t-statistics=0.79), but it is statistically insignificant.

Although the coefficient of lagged_beta*short_HL_dummy is insignificant, it does not mean short selling does not affect the alpha but only shows that it does not influence alpha through its associated beta. Therefore, the results do not contradict with the finding regards of the short selling effects dominate margin trading effects in regression 1.

In sum, I once again find the phenomenon of high-beta securities associated with low-alpha indeed exists in China through the difference-in-difference regression. Moreover, the lifted stock-specific margin constraints eliminate the low-alpha phenomenon for high-beta securities. Besides, the alpha of high margin trading securities increases more through its beta compared with the low margin trading securities. Last but not least, I find no evidence to show short selling level affects the securities alpha through its associated beta.

6.2 The Effect of Funding Constraints to BAB Return

BAB investment strategy involves borrowing and lending at risk-free rate. In this section, I would like to test how the BAB returns are affected by the funding constraints. FP use TED spread (3-month LIBOR – 3-month T-bill rate) as a proxy to measure the funding constraints in U.S. market. However, the T-bill market in China is not that active as U.S., the 3-month T-bill rate is not continuous in China. For example, if Chinese government does not issue 3-month T-bill in a particular month, the 3-month T-bill rate will be missing in that month. However, this phenomenon seldom happens in U.S. as the U.S. government offers 3-month T-bill security every month. For the reason of inactive T-bill market in China, I use risk-free rate obtained from CSMAR as a proxy for the T-bill rate in China. According to the description in CSMAR, the risk-free rate is one-year lump-sum deposit & withdrawal time deposit interest rate. Besides, I use SHIBOR rather than LIBOR to measure the funding constraints. In order to match with the

one year risk-free rate, I use one-year SHIBOR as well. Basically, the funding constraints are equal to the difference between one-year risk-free rate and one-year SHIBOR in China. When the funding constraints tighten, the spread is widened. Table 13 presents the how the BAB returns are affected by funding constraints.

<Insert Table 13 here>

In this table, the dependent variable is the time series BAB returns and the explanatory variables are the funding constraints (FC) spread and a series of control variables. FC spread is the difference between Shanghai Interbank Offered Rate (SHIBOR) and the risk-free rate. Lagged FC spread is the FC spread at the end of month t-1. Change in FC spread is defined as the FC spread at the end of month t minus FC spread at the end of month t-1. Beta spread is calculated as$(\beta_t^H - \beta_t^L)/(\beta_t^H * \beta_t^L)$, where β_t^H (β_t^L) is the beta of the short (long) component of BAB portfolio at the portfolio formation. Lagged BAB returns are the BAB returns at the end of month t-1. Lagged inflation is equal to one-year China Consumer Price Index inflation rate, lagged one month. Market return is the monthly return of the Chinese market portfolio (B-shares are excluded and the return is value-weighted). The data run from November 2006 (first available date for SHIBOR is on Oct 2006, but the lagged FC spread is only available on November 2006) to June 2014. Regression 1 shows the results without the control variables, while regression 2 reports the results with a series of control variables.

Regression 1 shows the lagged FC spread and change in FC spread are negatively related to BAB return, but only change in FC spread is statistically significant. After taking into account for a series control variables, regression 2 also has a similar conclusion as regression 1. Although the lagged FC spread is still insignificant, its associated t-statistics is stronger. Change in FC spread remains statistically significant when controlling for a series variables. This somehow

suggests that the BAB return is worse when the funding constraints are more binding. Since BAB portfolio requires investors to borrow or lend at risk-free rate in order to leverage or deleverage the low-beta and high-beta portfolio, the investors may encounter barriers when the bank tighten the funding constraints. Therefore, it may lead to an exacerbation of BAB return. The results are consistent with the hypothesis suggested by FP. Although they find lagged FC spread and change in FC spread are significantly negative related to BAB return, the sample period they employed for measuring funding constraints in U.S. is much longer than the available data in China. In fact, I believe that lagged FC spread will turn to be significant if the sample period that is available for measuring the funding constraints in China is longer.

The primary reason of this test is to provide a foresight for the investors that some external factors may indeed influence the performance of BAB portfolio. In fact, the high FC spread sends a signal or warning to the investors that the BAB return is going to decline in the future. For this reason, the investors should stop holding the BAB portfolio if the funding constraints tighten for a long period of time as the profitability of BAB keeps deteriorating and all the BAB returns may vanish in the future.

6.3 Beta Compression

In the above section, I find that the funding constraints indeed bring negative impact to BAB return. However, I also want to know how the funding liquidity risk influences the BAB portfolio beta. FP model predicts that the securities' beta is compressed toward one and the market sensitivity of BAB portfolio increases when funding liquidity risk is high.

I follow FP to construct the test. I use the volatility of FC spread as a proxy to measure the funding liquidity risk. The volatility of FC spread in month *t* is defined as $\sigma_t^{FCS} = \sqrt{\sum_{d \in month\ t} (\Delta FCS_d - \overline{\Delta FCS_t})^2}$, where *d* denotes the number of days in month *t*. As I want to test how the beta changes under different funding liquidity risk condition, this means I am estimating the conditional moments. Therefore, I need to use the volatility of FC spread lagged by one month to ensure that the conditional variable is known at the beginning of the measurement period. The data run from November 2006 (first available date for SHIBOR is on Oct 2006, but the change in FC spread is only available on November 2006) to June 2014. Table 14 presents the cross-sectional dispersion of beta in Panel A, while the conditional market beta is reported in Panel B.

<Insert Table 14 here>

Panel A reports the cross-sectional dispersion of beta in Chinese equities. The cross-sectional dispersion of beta is measured by standard deviation, mean absolute deviation and interquintile range. The time-series means of the dispersion measures for betas are reported according to the FC spread volatility. FC spread volatility is ranked in ascending order and is assigned into three groups (low, medium and high) based on the full sample breakpoints. Then the time-series dispersion measures are regressed on the full set of dummies (without the intercept). P1 (low FC spread volatility) to P3 (high FC spread volatility) represents the coefficients on a regression of the dispersion measures on a series of FC spread volatility dummies. According to Panel A in Table 14, all the dispersion measures (standard deviation, mean absolute deviation and interquintile range) give the same conclusion to show the cross-sectional dispersion of beta decreases as the FC spread volatility increases. The standard deviation of beta drops from 0.147 to 0.135. The mean absolute deviation also declines from

0.116 to 0.106, while the interquintile range decreases from 0.241 to 0.221. Moreover, the coefficients difference (P3-P1) Chi-square tests show all the desperation measures are significantly different when the FC spread volatility changes. The coefficients difference is -0.012 (Chi-square statistics=5.63) for standard deviation, while it is -0.010 (Chi-square statistics=5.40) for mean absolute deviation and -0.020 (Chi-square statistics=5.18) for interquintile range. All the differences are statistically significant at 5% level. The results provide strong evidence to prove that the betas of securities are less dispersed in a volatile credit condition, which is consistent with the findings proposed by FP. In fact, this finding leads to an interesting question. Since the BAB portfolio is constructed without taking into account for the funding liquidity risk, this means that the low-beta portfolio may be leveraged too much and the high-beta portfolio may be deleveraged too much in a volatile credit condition (the dispersion of beta is small). It may lead to an increase in market sensitivity of BAB portfolio.

In order to test if the conditional market beta of BAB portfolio increases when the funding liquidity risk rises, I follow FP to run a conditional regression. Panel B shows the conditional market betas of BAB portfolio based on FC spread volatility as of the previous month. The dependent variable is the time-series BAB returns. The explanatory variables are the relevant factors in Capital Asset Pricing Model (CAPM), Fama and French (1993) three-factor model and Carhart (1997) four-factor model. Only alpha (in percentage) and market beta are presented in Panel B. Market betas are allowed to vary across FC spread volatility conditions using the full set of dummies. P1 indicates the low FC spread volatility, while P3 represents the high FC spread volatility. The results in Panel B show the conditional market beta indeed varies as the funding liquidity risk changes, but it decreases first and increases again, which presents a U-shaped pattern. Moreover, the coefficient difference Chi-square tests are insignificant. FP find

the conditional market beta of BAB keeps increasing when the credit market is more volatile rather than presenting a U-shaped pattern. Therefore, the results are somehow inconsistent with the finding proposed by FP. I think the primary reason that caused this inconsistency is the short sample period of SHIBOR, which is only available after October 2006. However, the time-series BAB returns are available after June 1994, which means I need to abandon half of the time-series BAB returns in order to match the sample period of SHIBOR for measuring the funding liquidity risk when running the regression. Therefore, it causes the conditional market beta presents a U-shaped pattern and leads to insignificant results of coefficient difference Chi-square tests. Besides, the CAPM alpha is 0.57 (t-statistics=2.10), which is significant at 5% level. The three-factor alpha and four-factor alpha are 0.47% (t-statistics=1.75) and 0.45% (t-statistics=1.68). This shows the alpha remains statistically significant even when controlling for the time-varying market exposure.

In sum, I find evidences to support that the securities' betas become less dispersed under a volatile credit condition. In other words, the dispersion of beta for low-beta and high-beta securities becomes narrow. Although I find little evidence to show that BAB investors leverage too much for the low-beta portfolio and deleverage too much for high-beta portfolio, investors should also notice this issues, since the U-shaped pattern of conditional market beta and insignificant results of coefficient difference test are probably caused by the short sample period rather than the problem of the model itself.

7. Conclusion

I follow FP to construct this study. Moreover, I also develop a difference-in-difference (DID) regression in order to capture the effects of stock-specific margin constraints on stock. Fundamentally, the sample period covers from June 1994 to July 2014. (1) I examine whether the phenomenon of high-beta securities associated with low-alpha exits in China. (2) I investigate the profitability of betting against beta (BAB) portfolio and test its robustness. (3) I test the effects of stock-specific margin constraints on alpha based on the DID regression after China lifted the bans on margin trading and short selling. (4) I study how the BAB return is influenced by the funding constraints. (5) I inspect how the funding liquidity risk affects the market beta.

Firstly, I find empirical evidences to show the phenomenon of high-beta securities associated with low-alpha exits in China. The high-beta securities exhibit lower return and alpha on average, comparing with the low-beta securities. Even when controlling for CAPM, Fama and French (1993) three-factor and Charhart (1997) momentum factor, the results show the similar conclusion.

Secondly, I find the BAB portfolio provides significant return in China. Moreover, most of the significant return is driven by the long-side low-beta portfolio rather than the short-side high-beta portfolio. Therefore, the BAB return may still exist even when China prohibits the margin trading and short selling. Besides, I show the BAB investment strategy works better in big firm rather than small firm, and the market-neutral characteristic of BAB investment strategy performs better in big firm as well. I also find that the BAB return is not influenced by the January effect. The BAB return is still statistically significant even when excluding all the January return. Quintile, decile and annual rebalancing strategies can also generate significant

return, but the market-neutral characteristic is affected. I find the BAB portfolio can only generate significant return after the Chinese split share reform.

Thirdly, I find the relationship between beta and alpha is negative from DID regression. Moreover, I discover that the phenomenon of high-beta securities associated with low-alpha can be mitigated after the bans on margin trading and short selling were removed and given the securities that are on the designated list. Besides, I find margin trading level positively affects the securities alpha through its beta.

Fourthly, I use the difference between SHIBOR and risk-free rate as a proxy to measure the funding constraints. I find that the funding constraints bring negative impacts to BAB return. Basically, the BAB return tends to decline when the funding constraints tighten. In fact, this finding provides an insight for the investors that some external factors may deteriorate the performance of BAB portfolio.

Finally, I use the monthly standard deviation of the funding constraints spread (SHBIOR – risk-free rate) as a proxy to measure the funding liquidity risk. I find evidences to show that the desperation of beta inclines to decrease as the funding liquidity risk increases. Moreover, I find the conditional market beta exhibits a U-shaped pattern, which is inconsistent with FP as they find the conditional market beta should increase monotonically. One of the possible explanations that caused the inconsistent results is the short sample period of SHBIOR, which is only available after 2006.

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Figures and Tables

Table 1

Sample statistics.

This table reports the summary statistics for the sample. All the listed companies that are available on the China Stock Market & Accounting Research (CSMAR) database within the sample period are included, except B-shares. Main Board, SME Board and GEM Board are all included. Total represents the year end aggregate amount.

	Number of Firms	Negotiable Market Value (in billion RMB)	Total Market Value (in billion RMB)
Year	Total	Total	Total
1993	176	69	337
1994	288	81	356
1995	312	81	339
1996	515	253	954
1997	720	484	1,719
1998	825	556	1,936
1999	924	799	2,634
2000	1,060	1,557	4,783
2001	1,136	1,334	4,094
2002	1,193	1,173	3,627
2003	1,259	1,235	3,886
2004	1,350	1,103	3,419
2005	1,340	997	2,921
2006	1,363	2,307	5,495
2007	1,440	7,519	15,472
2008	1,559	4,035	7,818
2009	1,662	9,957	15,871
2010	1,990	12,396	19,596
2011	2,267	10,543	15,496
2012	2,432	11,753	16,645
2013	2,407	13,887	18,568
2014	2,456	19,458	26,341

Table 2

Equally-weighted portfolio returns: Sorted by beta.

This table shows beta-sorted calendar-time portfolio returns for Chinese stock market from July 1994 to June 2014. All the stocks that are available on the China Stock Market & Accounting Research (CSMAR) database within the sample period are included and monthly data are used, except B-shares. At the beginning of each calendar month, stocks are ranked in ascending order based on the past one year ex-ante betas from rolling regression. Stocks are assigned to decile portfolios by mainboard stocks breakpoints. The mainboard refers to the A shares in Shanghai Stock Exchange and Shenzhen Stock Exchange, excluding the SME and GEM stocks. Portfolios are rebalanced monthly. This table shows the excess returns and the risk-adjusted returns of equally-weighted portfolios. Returns and alpha are in monthly percent, and the numbers in parentheses are t-statistics based on Newey-West standard errors. The ex-ante beta is the average of time-series beta at portfolio formation and the realized beta is the realized loading from the Standard CAPM. Annualized volatilities (volatilities of monthly return x √12) and Sharpe ratios are also presented for reference. *** indicates significance at 1% level, ** indicates significance at 5% level and * indicates significance at 10% level.

Portfolio	P1 Low-Beta	P2	P3	P4	P5	P6	P7	P8	P9	P10 High-Beta
Excess Return	**1.24%****	**1.29%****	**1.36%****	**1.50%****	**1.38%****	**1.24%***	**1.29%***	**1.27%***	1.10%	1.10%
	(2.06)	(2.05)	(2.16)	(2.31)	(2.07)	(1.85)	(1.91)	(1.85)	(1.62)	(1.56)
CAPM Alpha	**0.51%****	**0.49%****	**0.54%*****	**0.65%*****	**0.52%****	**0.36%***	**0.40%***	0.37%	0.20%	0.17%
	(2.52)	(2.51)	(2.91)	(3.23)	(2.35)	(1.69)	(1.80)	(1.61)	(0.87)	(0.69)
Three-Factor Alpha	**0.43%****	**0.26%***	**0.29%****	**0.33%*****	0.11%	-0.05%	-0.05%	-0.12%	**-0.25%****	-0.26%
	(2.46)	(1.86)	(2.34)	(3.19)	(1.08)	(-0.61)	(-0.46)	(-1.20)	(-2.10)	(-1.63)
Four-Factor Alpha	**0.41%****	**0.25%***	**0.30%****	**0.37%*****	0.14%	-0.03%	-0.02%	-0.11%	**-0.22%***	**-0.27%***
	(2.33)	(1.78)	(2.40)	(3.52)	(1.44)	(-0.39)	(-0.22)	(-1.11)	(-1.90)	(-1.67)
Beta (ex_ante)	0.83	0.94	0.99	1.03	1.07	1.10	1.13	1.17	1.21	1.29
Beta (realized)	0.90	0.98	1.00	1.04	1.05	1.07	1.08	1.10	1.10	1.13
Volatility	30.70%	33.11%	33.65%	34.91%	35.52%	36.18%	36.67%	37.58%	37.49%	38.94%
Sharpe Ratio	0.48	0.47	0.49	0.52	0.47	0.41	0.42	0.41	0.35	0.34

Table 3

Portfolio performance and characteristics.

This table shows the returns of the zero-beta betting against beta (BAB) factor for Chinese stock market from July 1994 to June 2014. All the stocks that are available on the China Stock Market & Accounting Research (CSMAR) database within the sample period are included and monthly data are used, except B-shares. In order to construct the BAB factor, stocks are assigned to either low-beta or high-beta portfolio based on the past one year ex-ante betas from rolling regression. Stocks returns are weighted by the ranked betas, where the lower-beta securities have larger weights in the low-beta portfolio and higher-beta securities have larger weights in the high-beta portfolio. The portfolios are rebalanced at the beginning of each calendar month and are rescaled to have a beta of one at portfolio formation to maintain zero-beta BAB portfolio. The BAB factor is a zero-beta self-financing portfolio, which longs the low-beta portfolio and shorts the high-beta portfolio. Panel A reports the excess returns and the risk-adjusted returns for low-beta, high-beta and BAB portfolio. Returns and alphas are in monthly percent, and the numbers in parentheses are t-statistics based on Newey-West standard errors. The rescale factor is the average of the reciprocal of times-series portfolio beta. The ex-ante beta is the average of time-series beta at portfolio formation and the realized beta is the realized loading from the Standard CAPM. Annualized volatilities (volatilities of monthly return x $\sqrt{12}$) and Sharpe ratios are also presented for references. Panel B shows the portfolio characteristics. Return on asset (ROA), earnings before interest and tax margin (EBIT margin), turnover, book-to-market (BM ratio), past 12 months return are measured in percent. Total market value (size) is reported in million RMB. Amihud ratio is presented in percentage return for billion RMB trading volume. **** indicates significance at 0.01% level, *** indicates significance at 1% level, ** indicates significance at 5% level, and * indicates significance at 10% level.

Portfolio			
Panel A: Portfolio Performance	Low-Beta	High-Beta	BAB
Excess Return	**1.41%****	**0.97%***	**0.44%****
	(2.11)	(1.70)	(2.02)
CAPM Alpha	**0.56%*****	0.21%	**0.35%***
	(2.92)	(1.15)	(1.90)
Three-Factor Alpha	**0.34%*****	**-0.17%***	**0.51%*****
	(2.65)	(-1.92)	(3.01)
Four-Factor Alpha	**0.34%****	**-0.17%***	**0.51%*****
	(2.59)	(-1.89)	(2.91)
Rescale Factor	1.08	0.82	--
Beta (ex_ante)	1.00	1.00	0.00
Beta (realized)	1.04	0.93	0.11
Volatility	34.78%	31.47%	11.35%

Sharpe Ratio	0.49	0.37	0.46

Panel B: Portfolio Characteristics

Portfolio	Low-Beta	High-Beta	BAB
ROA	6.69%	4.30%	**2.38%******
			(19.10)
EBIT Margin	12.88%	9.66%	**3.22%******
			(6.62)
P/E	36.44	29.76	**6.67******
			(15.44)
Turnover	43.18%	41.72%	**1.46%***
			(1.75)
Size	6785	3366	**3419******
			(22.34)
BM Ratio	35.96%	30.75%	**5.21%******
			(10.03)
Past 12 Months Returns	24.82%	14.76%	**10.06%******
			(9.13)
Amihud Ratio	0.95%	0.70%	**0.25%******
			(10.15)

Table 4

Portfolio performance: Sorted by size.

This table shows the returns of the zero-beta betting against beta (BAB) factor sorted by size for Chinese stock market from July 1994 to June 2014. All the stocks that are available on the China Stock Market & Accounting Research (CSMAR) database within the sample period are included and monthly data are used, except B-shares. Before constructing the BAB factor, stocks are ranked in ascending order based on their size (total market value) in each month. Then the stocks are assigned to quintile portfolios by mainboard stocks breakpoints. The mainboard refers to the A shares in Shanghai Stock Exchange and Shenzhen Stock Exchange, excluding the SME and GEM stocks. In order to construct the BAB factor, stocks are assigned to either low-beta or high-beta portfolio based on the past one year ex-ante betas from rolling regression. Stocks returns are weighted by the ranked betas, where the lower-beta securities have larger weights in the low-beta portfolio and higher-beta securities have larger weights in the high-beta portfolio. The portfolios are rebalanced at the beginning of each calendar month and are rescaled to have a beta of one at portfolio formation to maintain zero-beta BAB portfolio. The BAB factor is a zero-beta self-financing portfolio, which longs the low-beta portfolio and shorts the high-beta portfolio. Panel A reports the excess returns and the risk-adjusted returns for low-beta, high-beta and BAB portfolio. Returns and alphas are in monthly percent, and the numbers in parentheses are t-statistics based on Newey-West standard errors. The ex-ante beta is the average of time-series beta at portfolio formation and the realized beta is the realized loading from the Standard CAPM. Annualized volatilities (volatilities of monthly return x $\sqrt{12}$) and Sharpe ratios are also presented for reference. *** indicates significance at 1% level, ** indicates significance at 5% level and * indicates significance at 10% level.

		Size				
Portfolio		1 (Small)	2	3	4	5 (Big)
Excess Return	Low_beta	**1.99%****	**1.45%****	**1.20%***	**1.23%***	0.91%
		(2.58)	(2.04)	(1.79)	(1.86)	(1.44)
	High_beta	**1.78%*****	**1.23%****	**0.98%***	0.66%	0.39%
		(2.77)	(2.04)	(1.70)	(1.18)	(0.71)
	BAB	*0.21%*	*0.22%*	*0.22%*	**0.57%****	**0.51%***
		(0.77)	*(0.96)*	*(1.08)*	(2.20)	(1.80)
CAPM Alpha	Low_beta	**1.08%*****	**0.59%****	0.35%	**0.40%***	0.10%
		(3.02)	(2.16)	(1.54)	(1.84)	(0.55)
	High_beta	**1.01%*****	**0.46%***	0.21%	-0.10%	**-0.37%*****
		(3.38)	(1.85)	(1.10)	(-0.62)	(-2.64)
	BAB	0.08%	0.14%	0.14%	**0.50%****	**0.47%***
		(0.32)	(0.71)	(0.80)	(2.16)	(1.74)

FF3 Alpha	Low_beta	**0.48%*** **	0.17%	0.06%	0.26%	**0.32%***
		(2.60)	(1.14)	(0.47)	(1.31)	(1.86)
	High_beta	**0.37%*** **	-0.09%	**-0.18%***	**-0.36%*** **	**-0.41%*** **
		(2.96)	(-0.90)	(-1.66)	(-2.94)	(-2.84)
	BAB	0.11%	0.26%	0.24%	**0.62%** **	**0.72%*** **
		(0.49)	(1.41)	(1.56)	(2.56)	(2.75)
FF4 Alpha	Low_beta	**0.51%*** **	0.19%	0.05%	0.24%	**0.32%***
		(2.77)	(1.21)	(0.38)	(1.20)	(1.79)
	High_beta	**0.37%*** **	-0.10%	**-0.19%***	**-0.36%*** **	**-0.39%*** **
		(2.89)	(-1.00)	(-1.77)	(-2.89)	(-2.62)
	BAB	0.15%	0.29%	0.24%	**0.59%** **	**0.70%** **
		(0.66)	(1.49)	(1.53)	(2.41)	(2.55)
Beta (Ex ante)	***BAB***	0	0	0	0	0
Beta (Realized)	***BAB***	0.16	0.10	0.10	0.08	0.06
Volatility	Low_beta	40.17%	36.41%	35.02%	34.34%	33.09%
	High_beta	34.38%	33.04%	31.66%	30.95%	30.73%
	BAB	14.20%	11.92%	10.34%	13.33%	15.65%
Sharpe Ratio	Low_beta	0.60	0.48	0.41	0.43	0.33
	High_beta	0.62	0.45	0.37	0.26	0.15
	BAB	0.18	0.22	0.26	0.51	0.39

Table 5

Portfolio performance and characteristics: Quintile Strategy.

This table shows beta-sorted calendar-time portfolio returns and the returns of the zero-beta betting against beta (BAB) factor for Chinese stock market from July 1994 to June 2014. All the stocks that are available on the China Stock Market & Accounting Research (CSMAR) database within the sample period are included and monthly data are used, except B-shares. At the beginning of each calendar month, stocks are ranked in ascending order based on the past one year ex-ante betas from rolling regression. The ranked stocks are assigned to quintiles portfolios by the mainboard breakpoints. The mainboard refers to the A shares in Shanghai Stock Exchange and Shenzhen Stock Exchange, excluding the SME and GEM stocks. All the stocks are beta-weighted in each portfolio. The portfolios are rebalanced at the beginning of each calendar month and are rescaled to have a beta of one at portfolio formation. The BAB factor is a zero-beta self-financing portfolio, which longs the low-beta portfolio and shorts the high-beta portfolio. To reduce the transaction costs, this table presents the BAB factor that longs (shorts) the bottom (top) 20% stocks based on the ranked betas rather than all stocks. Panel A reports the excess returns and risk-adjusted return for low-beta, high-beta and BAB portfolio. Returns and alphas are in monthly percent, and the numbers in parentheses are t-statistics based on Newey-West standard errors. The rescale factor is the average of the reciprocal of times-series portfolio beta. The ex-ante beta is the average of time-series portfolio beta at portfolio formation and the realized beta is the realized loading from the Standard CAPM. Annualized volatilities (volatilities of monthly return x √12) and Sharpe ratios are also presented for references. Panel B shows the portfolio characteristics. Return on asset (ROA), earnings before interest and tax margin (EBIT margin), turnover, book-to-market (BM ratio), past 12 months returns are measured in percent. Total market value (size) is reported in million RMB. Amihud ratio is presented in percentage return for billion RMB trading volume. **** indicates significance at 0.01% level, *** indicates significance at 1% level, ** indicates significance at 5% level and * indicates significance at 10% level.

Portfolio	P1 Low-beta	P2	P3	P4	P5 High-beta	P1 - P5
Panel A: Portfolio Performance						
Excess Return	**1.42%****	**1.42%****	**1.22%***	**1.12%***	0.90%	**0.52%***
	(2.05)	(2.24)	(1.96)	(1.87)	(1.60)	(1.83)
CAPM Alpha	**0.56%*****	**0.60%*****	**0.41%****	**0.33%***	0.15%	**0.41%***
	(2.63)	(3.17)	(2.01)	(1.71)	(0.81)	(1.67)
Three-Factor Alpha	**0.39%****	**0.31%*****	0.02%	-0.10%	**-0.21%***	**0.60%*****
	(2.35)	(2.88)	(0.19)	(-1.30)	(-1.92)	(2.68)
Four-Factor Alpha	**0.37%****	**0.33%*****	0.04%	-0.09%	**-0.21%***	**0.59%****
	(2.24)	(2.98)	(0.46)	(-1.24)	(-1.91)	(2.55)
Rescale Factor	1.14	0.99	0.92	0.87	0.80	--
Beta (ex_ante)	1.00	1.00	1.00	1.00	1.00	0.00

Beta (realized)	1.05	1.01	0.99	0.96	0.91	0.14
Volatility	35.61%	33.99%	33.34%	32.70%	31.01%	14.76%
Sharpe Ratio	0.48	0.50	0.44	0.41	0.35	0.43
Panel B: Portfolio Characteristics						
ROA	7.28%	5.92%	5.17%	4.51%	4.19%	**3.12%****** (18.18)
EBIT margin	13.81%	11.76%	10.76%	9.77%	9.61%	**4.25%****** (6.42)
P/E	38.58	33.83	31.04	30.72	29.47	**9.29****** (15.29)
Turnover	43.06%	43.48%	42.91%	42.09%	41.40%	1.65% (1.63)
Size	8335	4584	3547	3256	3429	**4905****** (21.24)
BM Ratio	35.81%	36.41%	35.35%	33.22%	29.47%	**6.35%****** (9.68)
Past 12 Months Returns	29.65%	17.85%	14.25%	13.51%	15.36%	**14.28%****** (10.31)
Amihud Ratio	0.96%	0.94%	0.89%	0.82%	0.64%	**0.32%****** (9.72)

Table 6

Portfolio performance and characteristics: Decile Strategy.

This table shows beta-sorted calendar-time portfolio returns and the returns of the zero-beta betting against beta (BAB) factor for Chinese stock market from July 1994 to June 2014. All the stocks that are available on the China Stock Market & Accounting Research (CSMAR) database within the sample period are included and monthly data are used, except B-shares. At the beginning of each calendar month, stocks are ranked in ascending order based on the past one year ex-ante betas from rolling regression. The ranked stocks are assigned to decile portfolios by the mainboard breakpoints. The mainboard refers to the A shares in Shanghai Stock Exchange and Shenzhen Stock Exchange, excluding the SME and GEM stocks. All the stocks are beta-weighted in each portfolio. The portfolios are rebalanced at the beginning of each calendar month and are rescaled to have a beta of one at portfolio formation. The BAB factor is a zero-beta self-financing portfolio, which longs the low-beta portfolio and shorts the high-beta portfolio. To reduce the transaction costs, this table presents the BAB factor that longs (shorts) the bottom (top) 10% stocks based on the ranked betas rather than all stocks. Panel A reports the excess returns and risk-adjusted returns for low-beta, high-beta and BAB portfolio. Returns and alphas are in monthly percent, and the numbers in parentheses are t-statistics based on Newey-West standard errors. The rescale factor is the average of the reciprocal of times-series portfolio beta. The ex-ante beta is the average of time-series portfolio beta at portfolio formation and the realized beta is the realized loading from the Standard CAPM. Annualized volatilities (volatilities of monthly return x $\sqrt{12}$) and Sharpe ratios are also presented for references. Panel B shows the portfolio characteristics. Return on asset (ROA), earnings before interest and tax margin (EBIT margin), turnover, book-to-market (BM ratio), past 12 months returns are measured in percent. Total market value (size) is reported in million RMB. Amihud ratio is presented in percentage return for billion RMB trading volume. **** indicates significance at 0.01% level, *** indicates significance at 1% level, ** indicates significance at 5% level and * indicates significance at 10% level.

Portfolio	P1 Low-Beta	P2	P3	P4	P5	P6	P7	P8	P9	P10 High-Beta	P1 - P10
Panel A: Portfolio Performance											
Excess Return	**1.44%****	**1.40%****	**1.39%****	**1.48%****	**1.28%****	**1.13%***	**1.14%***	**1.11%***	0.93%	0.87%	0.57%
	(2.01)	(2.07)	(2.17)	(2.33)	(2.03)	(1.84)	(1.90)	(1.85)	(1.63)	(1.57)	(1.58)
CAPM Alpha	**0.57%****	**0.54%****	**0.56%*****	**0.65%*****	**0.47%****	0.33%	**0.35%***	0.32%	0.17%	0.14%	0.44%
	(2.35)	(2.57)	(2.91)	(3.27)	(2.19)	(1.63)	(1.76)	(1.63)	(0.90)	(0.71)	(1.40)
Three-Factor Alpha	**0.48%****	**0.29%***	**0.30%****	**0.33%*****	0.08%	-0.07%	-0.07%	-0.12%	**-0.21%****	-0.21%	**0.68%****
	(2.30)	(1.93)	(2.31)	(3.19)	(0.73)	(-0.78)	(-0.83)	(-1.32)	(-2.16)	(-1.62)	(2.43)
Four-Factor Alpha	**0.46%****	**0.28%***	**0.31%****	**0.35%*****	0.11%	-0.05%	-0.06%	-0.11%	**-0.20%****	**-0.22%***	**0.68%****
	(2.17)	(1.85)	(2.35)	(3.42)	(1.06)	(-0.62)	(-0.71)	(-1.30)	(-2.01)	(-1.72)	(2.34)

Rescale Factor	1.21	1.07	1.01	0.97	0.94	0.91	0.88	0.86	0.83	0.77	--
Beta (ex_ante)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00
Beta (realized)	1.06	1.04	1.01	1.01	1.00	0.98	0.97	0.96	0.93	0.90	0.16
Volatility	36.43%	35.25%	34.09%	34.10%	33.79%	33.12%	32.87%	32.73%	31.54%	30.80%	18.28%
Sharpe Ratio	0.48	0.48	0.49	0.52	0.46	0.41	0.42	0.41	0.35	0.34	0.37
Panel B: Portfolio Characteristics											
ROA	7.95%	6.65%	6.15%	5.66%	5.39%	5.05%	4.71%	4.52%	4.37%	4.12%	**3.94%****** (17.61)
EBIT Margin	15.13%	12.59%	12.09%	11.41%	10.98%	10.66%	10.15%	9.81%	10.26%	9.29%	**6.02%****** (6.59)
P/E	41.80	35.43	34.43	33.44	31.54	30.89	30.82	31.47	31.17	28.73	**13.81****** (15.05)
Turnover	42.90%	43.15%	43.36%	43.66%	42.91%	42.85%	42.75%	41.69%	41.39%	41.36%	1.54% (1.31)
Size	10654	5882	4888	4081	3690	3412	3293	3237	3256	3561	**7093****** (19.32)
BM Ratio	36.24%	35.40%	36.66%	36.08%	35.88%	34.82%	33.83%	32.87%	31.62%	27.95%	**8.29%****** (10.31)
Past 12-Month Return	34.88%	23.79%	19.02%	15.97%	14.40%	14.06%	14.05%	13.19%	13.82%	16.47%	**18.41%****** (11.16)
Amihud Ratio	1.00%	0.91%	0.94%	0.93%	0.93%	0.86%	0.85%	0.81%	0.73%	0.57%	**0.43%****** (8.38)

Table 7

Portfolio performance: Excludes January.

This table shows the returns of the zero-beta betting against beta (BAB) factor for Chinese stock market from July 1994 to June 2014. All the stocks that are available on the China Stock Market & Accounting Research (CSMAR) database within the sample period are included and monthly data are used, except B-shares. January is also excluded to avoid January effect. In order to construct the BAB factor, stocks are assigned to either low-beta or high-beta portfolio based on the past one year ex-ante betas from rolling regression. Stocks returns are weighted by the ranked betas, where the lower-beta securities have larger weights in the low-beta portfolio and higher-beta securities have larger weights in the high-beta portfolio. The portfolios are rebalanced at the beginning of each calendar month and are rescaled to have a beta of one at portfolio formation to maintain zero-beta BAB portfolio. The BAB factor is a zero-beta self-financing portfolio, which longs the low-beta portfolio and shorts the high-beta portfolio. This table reports the excess returns and the risk-adjusted return for low-beta, high-beta and BAB portfolio. Returns and alphas are in monthly percent, and the numbers in parentheses are t-statistics based on Newey-West standard errors. The ex-ante beta is the average of time-series beta at portfolio formation and the realized beta is the realized loading from the Standard CAPM. Annualized volatilities (volatilities of monthly return x √12) and Sharpe ratios are also presented for references. *** indicates significance at 1% level, ** indicates significance at 5% level and * indicates significance at 10% level.

Portfolio	Low-Beta	High-Beta	BAB
Excess Return	**1.37%****	0.86%	**0.51%****
	(1.99)	(1.46)	(2.18)
CAPM Alpha	**0.58%*****	0.16%	**0.42%****
	(2.99)	(0.82)	(2.11)
Three-Factor Alpha	**0.38%*****	**-0.19%****	**0.57%*****
	(2.79)	(-2.02)	(3.10)
Four-Factor Alpha	**0.38%*****	**-0.19%****	**0.57%*****
	(2.76)	(-2.01)	(3.04)
Beta (ex_ante)	1.00	1.00	0.00
Beta (realized)	1.04	0.93	0.11
Volatility	35.04%	31.60%	11.50%
Sharpe Ratio	0.47	0.33	0.53

Table 8

Portfolio performance: Sub-period test for the split share reform.

This table shows the returns of the zero-beta betting against beta (BAB) factor for Chinese stock market from July 1994 to June 2014. The sample period is divided into two groups. The first group is before the split share reform, from July 1994 to June 2005. The second group is after the split share reform, from July 2005 to June 2014. All the stocks that are available on the China Stock Market & Accounting Research (CSMAR) database within the sample period are included and monthly data are used, except B-shares. In order to construct the BAB factor, stocks are assigned to either low-beta or high-beta portfolio based on the past one year ex-ante betas from rolling regression. Stocks returns are weighted by the ranked betas, where the lower-beta securities have larger weights in the low-beta portfolio and higher-beta securities have larger weights in the high-beta portfolio. The portfolios are rebalanced at the beginning of each calendar month and are rescaled to have a beta of one at portfolio formation to maintain zero-beta BAB portfolio. The BAB factor is a zero-beta self-financing portfolio, which longs the low-beta portfolio and shorts the high-beta portfolio. This table reports the excess returns and the risk-adjusted returns for low-beta, high-beta and BAB portfolio. Returns and alphas are in monthly percent, and the numbers in parentheses are t-statistics based on Newey-West standard errors. The ex-ante beta is the average of time-series beta at portfolio formation and the realized beta is the realized loading from the Standard CAPM. Annualized volatilities (volatilities of monthly return x √12) and Sharpe ratios are also presented for references. *** indicates significance at 1% level, ** indicates significance at 5% level and * indicates significance at 10% level.

	Before the reform July 1994 - June 2005			After the reform July 2005- June 2014		
Portfolio	Low-Beta	High-Beta	BAB	Low-Beta	High-Beta	BAB
Excess Return	0.59%	0.39%	0.20%	**2.41%****	**1.68%***	**0.73%****
	(0.72)	(0.53)	(0.64)	(2.30)	(1.90)	(2.62)
CAPM Alpha	0.24%	0.08%	0.16%	**0.93%****	0.35%	**0.58%****
	(1.41)	(0.34)	(0.57)	(2.58)	(1.18)	(2.55)
Three-Factor Alpha	**0.27%***	-0.17%	0.43%	**0.30%***	**-0.23%****	**0.53%****
	(1.70)	(-1.20)	(1.64)	(1.66)	(-2.28)	(2.49)
Four-Factor Alpha	**0.28%***	-0.17%	**0.44%***	0.25%	**-0.22%****	**0.48%****
	(1.74)	(-1.20)	(1.67)	(1.47)	(-2.15)	(2.30)
Beta (ex_ante)	1.00	1.00	0.00	1.00	1.00	0.00
Beta (realized)	1.02	0.91	0.11	1.05	0.95	0.11
Volatility	33.75%	31.00%	12.39%	35.85%	32.01%	9.90%
Sharpe Ratio	0.21	0.15	0.19	0.81	0.63	0.89

Table 9

Betting against beta (BAB) portfolio monthly and cumulative return: Monthly rebalancing.

This table reports the average returns of the zero-beta betting against beta (BAB) factors by different holding period for Chinese stock market from July 1994 to June 2014. All the stocks that are available on the China Stock Market & Accounting Research (CSMAR) database within the sample period are included and monthly data are used, except B-shares. The BAB factor is a zero-beta self-financing portfolio, which longs the low-beta portfolio and shorts the high-beta portfolio. The BAB portfolio formation starts at the end of each month, t represents the month after the portfolio formation. Autocorrelation-consistent Newey-West standard errors are used to calculate the t-statistics. **** indicates significance at 0.01% level, *** indicates significance at 1% level, ** indicates significance at 5% level and * indicates significance at 10% level.

t	Monthly Return	Cumulative Return	t	Monthly Return	Cumulative Return	t	Monthly Return	Cumulative Return
1	**0.44%****	**0.44%****	13	**0.66%*****	**10.20%******	25	0.15%	**16.26%******
	(2.02)	(2.02)		(3.01)	(5.98)		(0.73)	(8.00)
2	**0.59%*****	**1.04%*****	14	**0.58%*****	**10.96%******	26	0.23%	**16.49%******
	(2.65)	(2.63)		(2.66)	(6.05)		(1.27)	(8.22)
3	**0.65%*****	**1.74%*****	15	**0.56%****	**11.69%******	27	0.15%	**16.68%******
	(2.82)	(3.14)		(2.59)	(6.12)		(0.80)	(8.33)
4	**0.79%*****	**2.60%*****	16	**0.53%****	**12.34%******	28	0.10%	**16.84%******
	(3.51)	(3.69)		(2.49)	(6.23)		(0.53)	(8.43)
5	**0.77%*****	**3.45%******	17	**0.50%****	**12.93%******	29	0.18%	**17.04%******
	(3.50)	(4.13)		(2.28)	(6.40)		(1.04)	(8.57)
6	**0.70%*****	**4.23%******	18	**0.50%****	**13.51%******	30	0.20%	**17.23%******
	(3.13)	(4.44)		(2.38)	(6.62)		(1.15)	(8.70)
7	**0.73%*****	**5.07%******	19	**0.50%****	**14.07%******	31	0.22%	**17.52%******
	(3.31)	(4.67)		(2.44)	(6.85)		(1.27)	(8.84)
8	**0.71%*****	**5.89%******	20	**0.51%****	**14.64%******	32	**0.30%***	**17.88%******
	(3.30)	(4.91)		(2.50)	(7.09)		(1.72)	(9.04)
9	**0.76%*****	**6.78%******	21	**0.43%****	**15.08%******	33	**0.31%***	**18.17%******
	(3.40)	(5.18)		(2.19)	(7.32)		(1.67)	(9.27)
10	**0.74%*****	**7.68%******	22	**0.34%***	**15.44%******	34	0.30%	**18.42%******
	(3.33)	(5.42)		(1.80)	(7.53)		(1.61)	(9.44)
11	**0.73%*****	**8.53%******	23	**0.34%***	**15.84%******	35	0.18%	**18.61%******
	(3.33)	(5.70)		(1.78)	(7.74)		(0.99)	(9.50)
12	**0.66%*****	**9.34%******	24	0.21%	**16.08%******	36	0.22%	**18.83%******
	(3.01)	(5.87)		(1.00)	(7.88)		(1.21)	(9.55)

Table 10

Portfolio performance: Annual rebalanced BAB portfolio.

This table shows the returns of the zero-beta betting against beta (BAB) factor for Chinese stock market from July 1994 to June 2014. All the stocks that are available on the China Stock Market & Accounting Research (CSMAR) database within the sample period are included and monthly data are used, except B-shares. In order to construct the BAB factor, stocks are assigned to either low-beta or high-beta portfolio based on the past one year ex-ante betas from rolling regression. Stocks returns are weighted by the ranked betas, where the lower-beta securities have larger weights in the low-beta portfolio and higher-beta securities have larger weights in the high-beta portfolio. To reduce the transaction costs, the portfolios are rebalanced at the end of June each year rather than at the beginning of each calendar month and the holding period of the portfolios are set to be one year. The BAB factor is a zero-beta self-financing portfolio, which longs the low-beta portfolio and shorts the high-beta portfolio. This table presents the excess returns and the risk-adjusted returns for low-beta, high-beta and BAB portfolio. Returns and alphas are in annual percentage rate, and the numbers in parentheses are t-statistics based on Newey-West standard errors. The ex-ante beta is the average of time-series beta at portfolio formation and the realized beta is the realized loading from the Standard CAPM. Annual volatilities and Sharpe ratios are also presented for references. *** indicates significance at 1% level, ** indicates significance at 5% level and * indicates significance at 10% level.

Portfolio	Low-Beta	High-Beta	BAB
Excess Return	**17.93%***	10.31%	**6.12%****
	(1.76)	(1.43)	(2.41)
CAPM Alpha	**6.33%*****	2.38%	**3.96%****
	(2.94)	(1.03)	(2.42)
Three-Factor Alpha	**4.78%*****	-1.86%	**4.99%*****
	(3.84)	(-1.42)	(2.96)
Four-Factor Alpha	**5.36%*****	**-2.46%***	**5.98%*****
	(3.69)	(-1.80)	(3.10)
Beta (ex_ante)	1.00	1.00	0.00
Beta (realized)	1.06	0.73	0.20
Volatility	46.55%	32.96%	11.82%
Sharpe Ratio	0.39	0.31	0.52

Table 11

Betting against beta (BAB) portfolio monthly and cumulative return: Annual rebalancing.

This table reports the average returns of the zero-beta betting against beta (BAB) factors by different holding period for Chinese stock market from July 1994 to June 2014. All the stocks that are available on the China Stock Market & Accounting Research (CSMAR) database within the sample period are included and monthly data are used, except B-shares. The BAB factor is a zero-beta self-financing portfolio, which longs the low-beta portfolio and shorts the high-beta portfolio. The BAB portfolio formation starts at the end of June each year, t represents the month after the portfolio formation. Autocorrelation-consistent Newey-West standard errors are used to calculate the t-statistics. ** indicates significance at 5% level and * indicates significance at 10% level.

t	Monthly Return	Cumulative Return	t	Monthly Return	Cumulative Return	t	Monthly Return	Cumulative Return
1	-0.22%	-0.22%	13	1.36%	**8.04%****	25	-1.44%	**12.69%****
	(-0.36)	(-0.36)		(1.07)	(2.22)		(-0.98)	(2.16)
2	0.84%	0.55%	14	0.17%	**8.40%****	26	-0.01%	**12.62%****
	(1.23)	(1.08)		(0.39)	(2.13)		(-0.02)	(2.16)
3	-0.38%	0.19%	15	-0.54%	**7.83%***	27	0.06%	**12.46%****
	(-0.47)	(0.18)		(-1.30)	(1.98)		(0.14)	(2.24)
4	-0.54%	-0.33%	16	0.89%	**9.33%***	28	-0.71%	**12.28%***
	(-1.38)	(-0.28)		(0.74)	(1.78)		(-0.68)	(1.95)
5	0.72%	0.34%	17	0.77%	**10.43%***	29	-0.08%	**12.08%***
	(1.20)	(0.30)		(1.27)	(1.81)		(-0.11)	(2.02)
6	0.95%	1.28%	18	0.59%	**10.67%***	30	0.76%	**12.89%***
	(1.30)	(0.98)		(0.73)	(2.08)		(1.37)	(2.10)
7	-0.17%	1.18%	19	0.23%	**11.16%***	31	-0.19%	**12.82%***
	(-0.34)	(0.73)		(0.38)	(1.99)		(-0.30)	(2.06)
8	0.17%	1.36%	20	0.59%	**11.52%****	32	**0.96%****	**13.62%****
	(0.43)	(0.81)		(1.60)	(2.21)		(2.45)	(2.26)
9	1.07%	2.33%	21	0.31%	**11.73%****	33	0.38%	**13.67%****
	(1.36)	(1.48)		(0.73)	(2.31)		(0.62)	(2.39)
10	**1.54%****	**4.00%***	22	0.04%	**11.68%****	34	1.19%	**14.82%****
	(2.45)	(1.99)		(0.05)	(2.38)		(1.30)	(2.55)
11	1.17%	**5.27%****	23	0.87%	**12.82%****	35	0.28%	**15.18%****
	(1.19)	(2.17)		(1.38)	(2.44)		(0.42)	(2.58)
12	0.80%	**6.12%****	24	0.58%	**13.51%****	36	-0.77%	**14.27%****
	(1.26)	(2.41)		(1.03)	(2.47)		(-1.17)	(2.50)

Table 12

The effect of stock-specific margin constraints to alpha.

This table reports how the beta affects alpha under the margin constraints condition. Alphas and betas are calculated by the rolling regression (CAPM) based on the past one year daily data. The dependent variable of the following three regressions is the rolling alphas (in percentage). The explanatory variables are the rolling betas and a series of interaction dummies variables with rolling betas. Lagged_TS_dummy is the time-series dummy, lagged by one month. As China market lifted the bans on margin trading and short selling in March 2010, Lagged_TS_dummy will be assigned to 1 one month after that date, 0 otherwise. List_dummy is the cross-sectional dummy for stocks. By using June 2014 as the breakpoint, List_dummy is equal to 1 (0) if the stocks that are allowed (not allowed) for margin trading and short selling. Indeed, if List_dummy is equal to 1 (0), it is considered as treatment group (control group). Margin_HL_dummy (Short_HL_dummy) measure the degree of margin trading (short selling) level under the condition that margin trading and short selling are allowed (after March 2010) and given the stocks that are on the list for margin trading and short selling. Margin trading (short selling) level is defined as the past 12 months rolling sum of the margin trading (short selling) amounts divided by year-end tradable/negotiable market value. In each calendar month, the average margin trading (short selling) level is obtained. If the margin trading (short selling) level is above the average margin trading level, margin_HL_dummy (short_HL_dummy) will be assigned to 1, 0 otherwise. Regression 1 is the difference in difference regression, where the data run from July 1994 to June 2014. Regression 2 and 3 are the stock fixed effect regression, where the data run from March 2010 to June 2014. Only the stocks that are allowed for margin trading and short selling are considered as sample in regression 2 and 3. The numbers in parentheses are t-statistics. **** indicates significance at 0.01% level, *** indicates significance at 1% level, ** indicates significance at 5% level and * indicates significance at 10% level.

	(1)	(2)	(3)
Intercept	**0.0431****		
	(21.01)		
List_dummy	**0.0342****		
	(9.89)		
Lagged_TS_dummy	**0.0584****		
	(16.68)		
List_dummy*TS_dummy	**-0.0259****		
	(-4.59)		
lagged_beta	**-0.0385****	**0.0458****	**0.0431****
	(-21.28)	(5.05)	(4.45)
lagged_beta*list_dummy	**-0.0150****		
	(-4.87)		
lagged_beta*lagged_TS_dummy	**-0.0381****		
	(-12.70)		
lagged_beta*list_dummy*lagged_TS_dummy	**0.0237****		
	(4.88)		
lagged_beta*margin_HL_dummy		**0.0187****	**0.0187****
		(6.68)	(6.70)
lagged_beta*short_HL_dummy			0.0023
			(0.79)

Table 13

The effect of funding constraints to betting against beta (BAB) returns.

This table presents the effect of funding constraints to betting against beta (BAB) returns. The dependent variable is the time series BAB returns and the explanatory variables are the funding constraints (FC) spread and a series of control variables. FC spread is the difference between Shanghai Interbank Offered Rate (SHIBOR) and the risk-free rate. Lagged FC spread is the FC spread at the end of month t-1. Change in FC spread is defined as the FC spread at the end of month t minus FC spread at the end of month t-1. Beta spread is calculated as $(\beta_t^H - \beta_t^L)/(\beta_t^H * \beta_t^L)$, where β_t^H (β_t^L) is the beta of the short (long) component of BAB portfolio at the portfolio formation. Lagged BAB returns is the BAB returns at the end of month t-1. Lagged inflation is equal to one-year China Consumer Price Index inflation rate, lagged one month. Market return is the monthly return of the Chinese market portfolio (B-shares are excluded and the return is value-weighted). The data run from November 2006 (first available date for SHIBOR is on Oct 2006, but the lagged FC spread is only available on November 2006) to June 2014. Regression 1 shows the results without the control variables, while regression 2 reports the results with a series of control variables. Number of observations and Adjusted R square are presented for references. The numbers in parentheses are t-statistics based on Newey-West standard errors. ** indicates significance at 5% level and * indicates significance at 10% level.

Dependent variable: BAB return	(1)	(2)
Lagged FC spread	-0.398	-0.768
	(-1.28)	(-1.50)
Change in FC spread	**-3.646****	**-3.513****
	(-2.30)	(-2.21)
Beta spread		0.174
		(1.60)
Lagged BAB return		-0.017
		(-0.11)
Lagged inflation		-0.062
		(-0.58)
Market return		**0.073****
		(2.18)
Number of observations	92	92
Adjusted R square	0.048	0.111

Table 14

Beta compression.

This table shows the cross-sectional and time-series beta compression. Panel A reports the cross-sectional dispersion of beta in Chinese equities. The cross-sectional dispersion of beta is measured by standard deviation, mean absolute deviation and interquintile range. The time-series means of the dispersion measures for betas are reported according to the funding constraints spread (FC) volatility. FC spread volatility is defined as the standard deviation of the daily change in difference between Shanghai Interbank Offered Rate (SHIBOR) and the risk-free rate in the previous month. FC spread volatility is ranked in ascending order and is assigned into three groups based on the full sample breakpoints. Then the time-series dispersion measures are regressed on the full set of dummies (without the intercept). P1 (low FC spread volatility) to P3 (high FC spread volatility) represent the coefficients on a regression of the dispersion measure on a series of FC spread volatility dummies. Panel B shows the conditional market betas of the betting against beta (BAB) portfolio based on FC spread volatility as of the previous month. The dependent variable is the time-series BAB returns. The explanatory variables are the relevant factors in Capital Asset Pricing Model (CAPM), Fama and French (1993) three-factor model and Carhart (1997) four-factor model. Only alpha (in percentage) and market beta are presented in Panel B. Market betas are allowed to vary across FC spread volatility conditions using the full set of dummies. The data run from November 2006 (first available date for SHIBOR is on Oct 2006, but the change in FC spread is only available on November 2006) to June 2014. The numbers in parentheses are t-statistics (except the coefficient difference tests are Chi-square statistics) based on Newey-West standard errors. *** indicates significance at 1%, ** indicates significance at 5% level and * indicates significance at 10% level.

Panel A	Cross-sectional dispersion		
	Standard deviation	Mean absolute deviation	Interquintile range
All	0.139	0.110	0.229
P1 (low FC spread volatility)	0.147	0.116	0.241
P2	0.137	0.108	0.224
P3 (high FC spread volatility)	0.135	0.106	0.221
P3 - P1	**-0.012****	**-0.010****	**-0.020****
	(5.63)	(5.40)	(5.18)

Panel B		Conditional market beta			
	Alpha	P1 (low FC volatility)	P2	P3 (high FC volatility)	P3 - P1
CAPM	**0.57%****	**0.19*****	0.03	**0.09***	-0.10
	(2.10)	(3.78)	(0.56)	(1.77)	(2.12)
Control for three factors	**0.47%***	**0.19*****	0.03	**0.11****	-0.08
	(1.75)	(3.78)	(0.70)	(2.19)	(1.27)
Control for four factors	**0.45%***	**0.19*****	0.05	**0.09***	-0.10
	(1.68)	(3.93)	(0.95)	(1.91)	(1.94)

Time series of Cumulative BAB portoflio Returns –Monthly Rebalancing

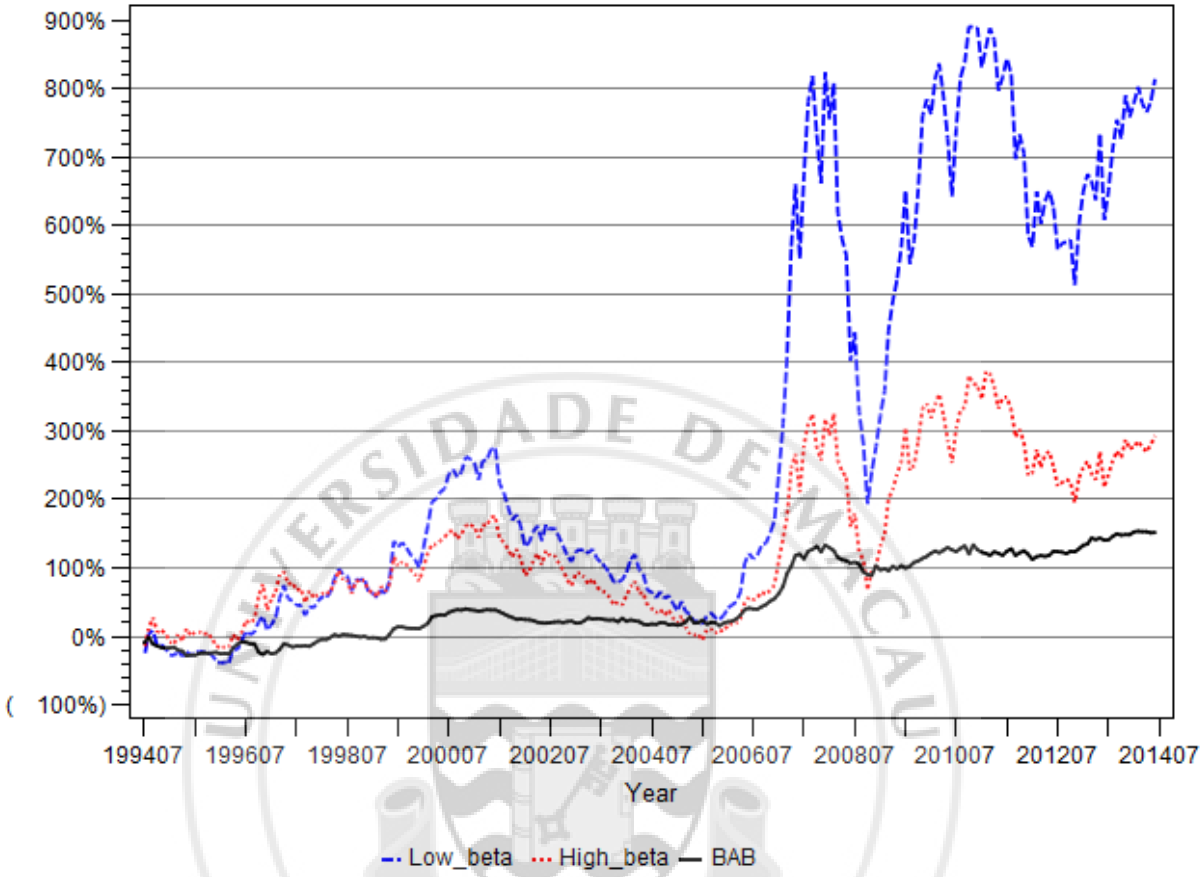

Fig. 1. Time series of cumulative returns for monthly rebalanced portfolio. This figure plots the cumulative returns of low/high-beta portfolios as well as the BAB portfolio (longs the low-beta portfolio and shorts the high-beta portfolio) across time. The portfolios are rebalanced at the beginning of each calendar month. The sample period is from July 1994 to June 2014.

Time series of Cumulative BAB portoflio Returns –Annual Rebalancing

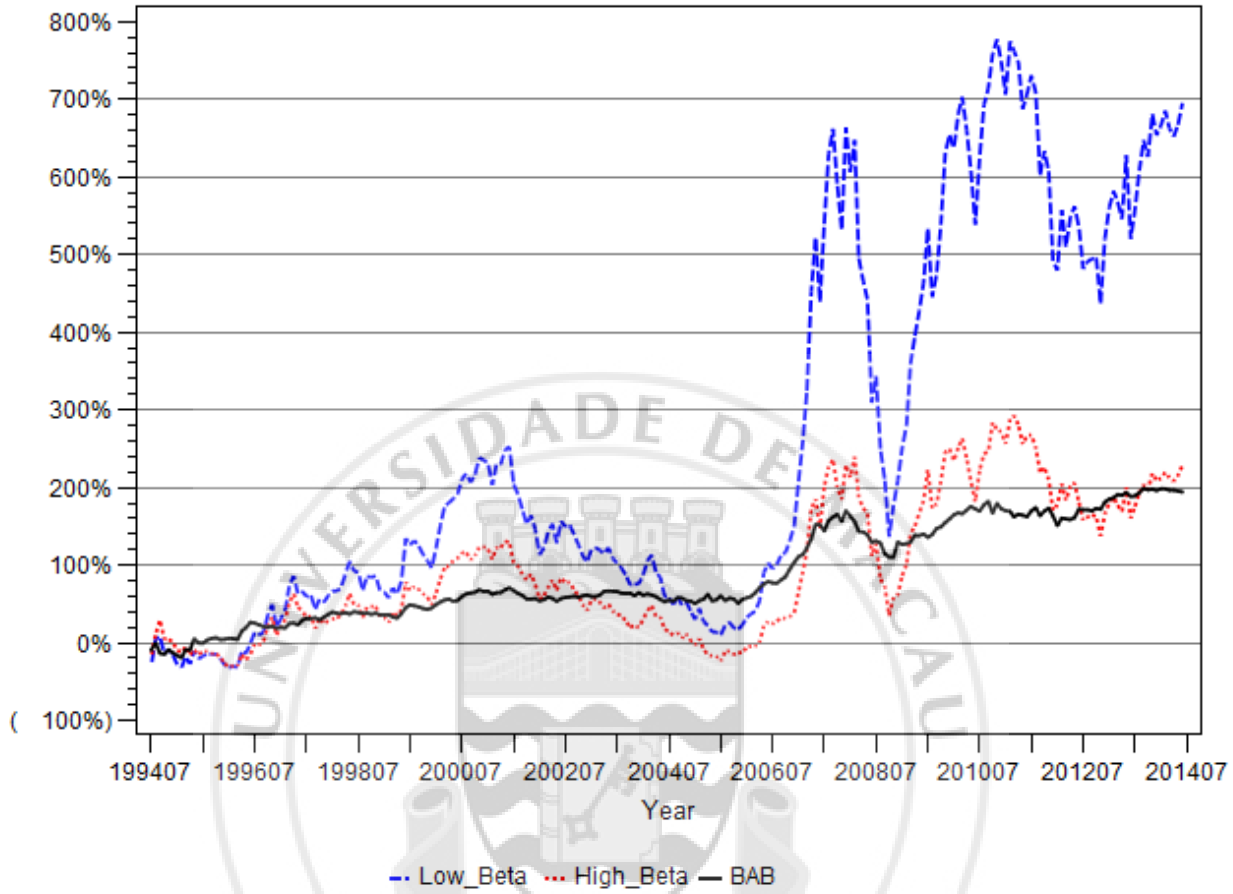

Fig. 2. Time series of cumulative returns for annual rebalanced portfolio. This figure plots the cumulative returns of low/high-beta portfolios as well as the BAB portfolio (longs the low-beta portfolio and shorts the high-beta portfolio) across time. The portfolios are rebalanced at the end of June each year. The sample period is from July 1994 to June 2014.

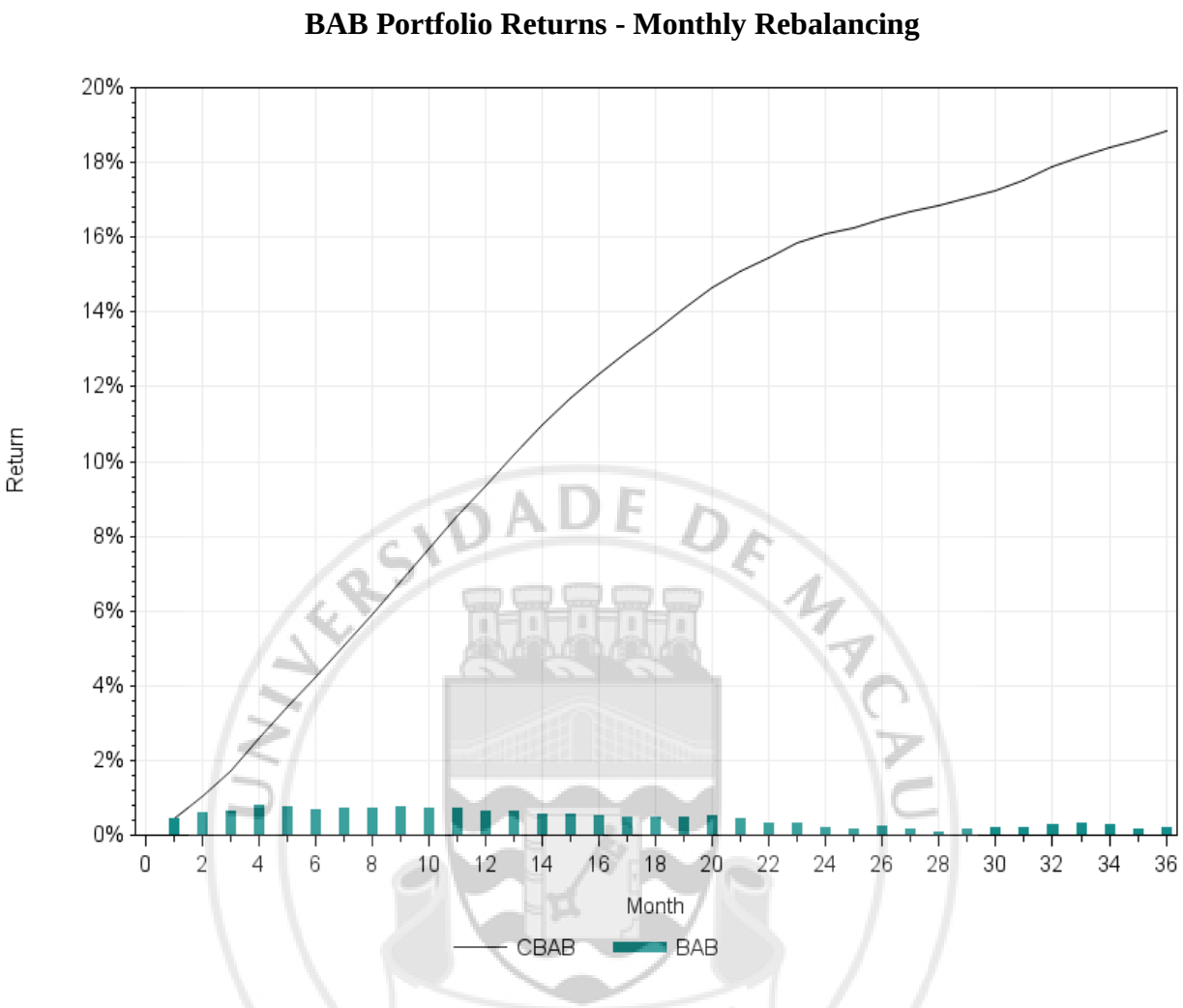

Fig. 3. The monthly and cumulative return of monthly rebalanced betting against beta (BAB) portfolio. This figure plots the monthly returns of BAB portfolio (longs the low-beta portfolio and shorts the high-beta portfolio) following the portfolio formation date. The time interval following the portfolio formation date varies from 1 month to 36 months. The portfolios are rebalanced at the beginning of each calendar month. The sample period is from July 1994 to June 2014. The bars (BAB) represent the monthly returns after the portfolio formation, where the solid line (CBAB) indicates the cumulative/holding period returns.

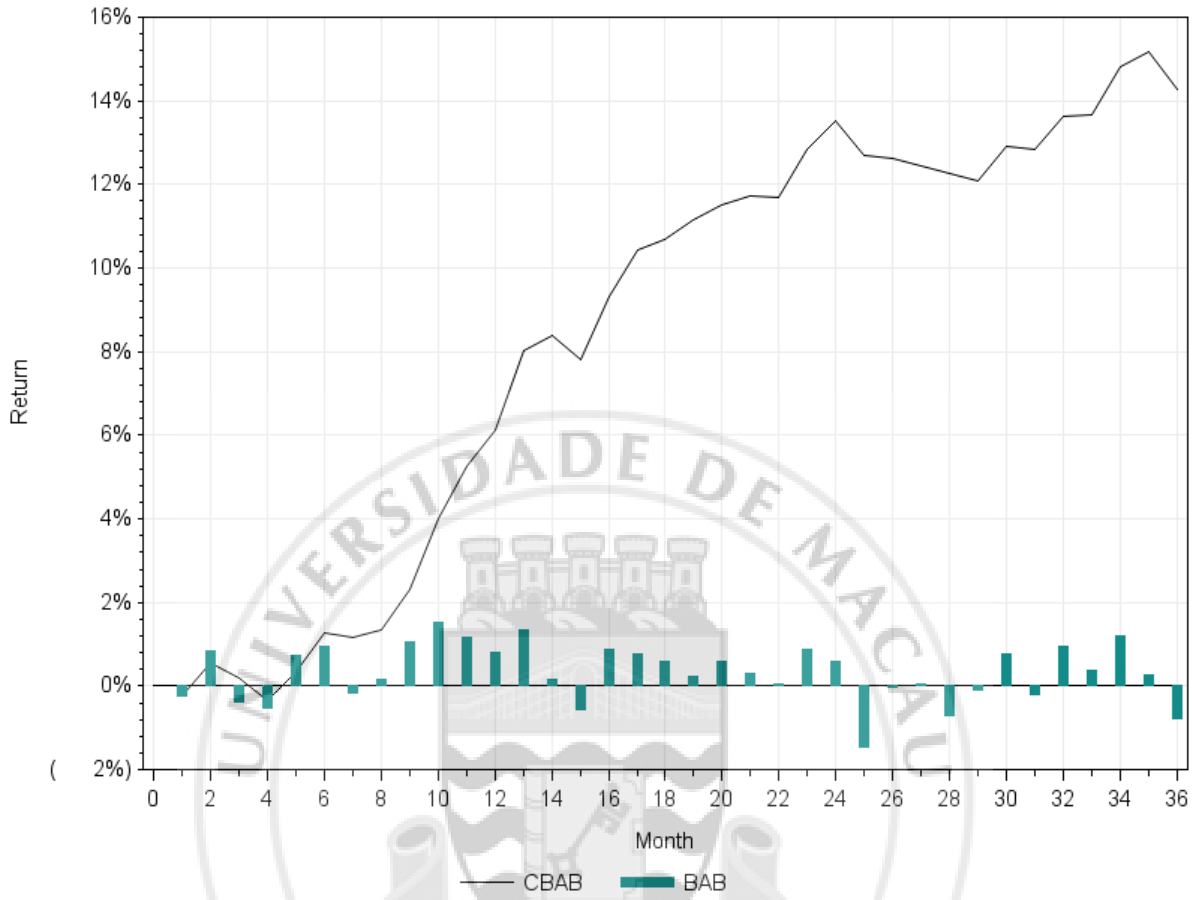

Fig. 4. The monthly and cumulative return of annual rebalanced betting against beta (BAB) portfolio. This figure plots the monthly returns of BAB portfolio (longs the low-beta portfolio and shorts the high-beta portfolio) following the portfolio formation date. The time interval following the following the portfolio formation date varies from 1 month to 36 months. The portfolios are rebalanced at the end of June each year. The sample period is from July 1994 to June 2014. The bars (BAB) represent the monthly returns after the portfolio formation, where the solid line (CBAB) indicates the cumulative/holding period returns.