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Beta anomaly in the stock market: is betting against beta a robust fact?

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Abstract

While the positive relationship between beta of a stock and its future return is implied by CAPM, empirical literature does not support this proposition. The recent advancements in risk-return relationship have documented the beta anomaly, or better still betting against beta, as the most complicated anomaly in finance. In this paper, the authors study the robustness of betting against beta phenomenon in the stock market via investigating it on absolute return and risk-adjusted basis using US market data over the period 1984-2012. To do this, beta-sorted quintile portfolios are used to estimate beta beside four multi-factor models. The results obtained provide evidence for existence of betting against beta on risk-adjusted basis only. Implications, discussion, and future research directions are discussed at the end of the paper.

Keywords:

Systematic Risk; Beta; Abnormal risk-return relationship; CAPM; Financial engineering

1 Introduction

The positive beta- return relationship implied by CAPM is empirically flat or even negative in stock market (Frazzini and Pederson, 2014). It has been observed that high beta stocks provide lower and low beta stocks provide higher returns than that of expected returns. This beta conundrum has been labeled as Betting against Beta (BAB henceforth) in the financial literature and Baker et al. (2011) named it the greatest anomaly in finance.

Capital asset pricing model (CAPM) of Sharpe (1964), Lintner (1965), and Black (1972) offers the most popular analytical approach for evaluating the motif of the risk-return relationship of a stock. According to CAPM, a stock's sensitivity to market portfolio or "beta" determines its expected return. However, the empirical success of CAPM has been qualified; likewise, other factors have been reported to explain the cross-section of stock returns. Factors such as market capitalization (Banz, 1981), book-to-market value (Fama and French, 1993), liquidity (Pastor and Stambaugh, 2001), and profitability (Novy-Marx, 2014) have been identified to explain cross-sectional stock returns consistently.

Be that as it may, recent papers have not found empirically reliable and robust link between beta and future stock returns (e.g. Frazzini and Pedersen, 2014) because Low beta stocks beget higher than expected return and high beta stocks generate lower. Beta risk anomaly makes an allusion to incorporation of beta and volatility anomalies. Volatility anomaly hints to the empirical finding that shows low volatility stocks provide higher returns than high volatility stocks (Blitz and van Vliet, 2007; Ang et al., 2008). The finding implies that prices are not right or the risk measures are wrong. There is theoretical and empirical contexts to confirm and explain BAB (e.g. Black et al., 1972; Fama and French, 1993; Blitz and van Vliet, 2007; Bali and Cakici, 2008; Baker et al., 2011, Frazzini and Pederson, 2014; Bali et al., 2014, Buchner and Wagner, 2016). Table 1 represents summary of explanations introduced in previous studies of BAB phenomenon.

Table 1. Summary of explanations for BAB.

Explanation	Source
Borrowing restrictions	Black (1972) Blitz and van Vliet (2007) Frazzini and Pedersen (2014)
Benchmarking	Baker, Bradley, and Wurgler (2011)
Decentralized investment approach	Blitz and van Vliet (2007)
Psychology (e.g. overconfidence, representativeness, lottery demand)	Blitz and van Vliet (2007) Baker et al. (2011) Bali et al. (2014)

In a recent preeminent paper, Frazzini and Pederson show that the beta-return relationship is flat or modestly increasing during the longer sample period from 1926 to 2012 highlighting the positive relation during the earlier century. They construct a BAB factor going long low beta stocks while shorting high beta stocks, this factor realizes positive and statistically significant returns. The kernel of BAB factor implicates that to make a profit from BAB phenomenon the investors need to lever up low beta stocks in order to capitalize the attractive risk-return feature. Thus, Present study is being directed to investigate the robustness of BAB phenomenon in the stock market based on absolute return and risk adjusted return. Although, different empirical settings provide somewhat different results for BAB, in this study researchers take a conservative approach in studying BAB by consolidating empirical elements having produced modest results erstwhile. The question is whether the betting against beta still exists in the stock market considering this conservative approach.

The empirical approach in this context differs from the previous studies in some important ways. Firstly, the authors employ annual rebalancing in the portfolios while the previous literature has used almost exclusively monthly rebalancing. The annual rebalancing provides less costs if an investor wants to benefit monetarily from the anomaly as it requires trading once a year compared to 12 times yearly. On the other hand, it is arguable if portfolios formed at the end of June of year t based on previous 60- and 36-month betas reflect their betas during the following 12 months. Although, all historical beta measures are only rough estimates and also forward-looking measures are hard to find, there is no certainty that even the forward-looking betas are accurate estimators. However, the combination of 60- and 36-month beta estimation periods mitigates this concern and the beta exposures are rather stable during one year.

Secondly, the combination of i) having equal number of shares in a portfolio compared to CRSP breakpoints, ii) equal-weighting in calculating the portfolio returns compared to value weighting, iii) long estimation period of beta, and iv) the exclusion of the most illiquid stocks (share price) is unique and provides a further robustness test to validate the existence of BAB in the stock market. All the above empirical choices have provided less significant results in the previous experiments meaning that if the BAB phenomenon is found in this sample, it is robust.

The results of the present study provide a practical insightful perspective for investors help them make more lucrative decision via paying attention to BAB phenomenon in the stock market and reduce the risk of their investment. Lastly, the researchers use stock return data from CRSP between 1984 and 2012 to sort stocks into quintile portfolios based on beta. The remainder of the paper is organized as follows: section 2 provides hypotheses developments and methodology of the study. Section 3 presents results. In Section 4 the discussion is presented. Section 5 concludes.

2 Hypotheses development and research methodology and

2-1 Hypotheses development

The hypotheses are constructed to answer the research question. The research question is whether BAB exists in the stock market robustly. The empirical literature documents the proposition that BAB exists in the stock market (e.g. Black et al., 1972; Frazzini and Pedersen, 2014). However, Bali and Cakici (2008) show that the empirical robustness of idiosyncratic anomaly is sensitive to empirical choices. The definition of the BAB so far has been vague. It has simply meant any situation where low (high) beta provides better (worse) returns than expected returns. But compared to what? To clarify, the authors make a distinction between excess returns and risk-adjusted returns in studying BAB phenomenon. Therefore, the hypotheses are formed as:

- Hypothesis 1. BAB phenomenon does exist on absolute return basis;
- Hypothesis 2. BAB phenomenon does exist on risk-adjusted basis.

BAB phenomenon has been more significant on risk-adjusted basis in the literature. It is still somewhat ambiguous what is meant by risk. There are hundreds of factors in the finance literature (Harvey, 2015; Novy-Marx, 2014) supposedly explaining stock returns and not all of them represent risk exposures. Besides, risk-adjusted or factor-adjusted returns are sensitive to the chosen factors. In this paper, CAPM as well as the most traditional multifactor models are used basically to assess whether low (high) beta provide positive (negative) alpha.

The multifactor regression approach follows Black et al. (1972) and Fama and French (1993). Monthly excess returns of stock portfolios are regressed on the excess return on market and returns according to zero-cost strategies upon empirical factors known to explain stock returns. The approach provides a well-defined test for an asset pricing model. A model that is to explain the average stock returns should produce undistinguishable intercepts from zero because of utilizing of excess returns and returns on zero-cost strategies. Most importantly, this approach gives a simple measure to detect abnormal returns by focusing on the regression alpha.

2-2 Methodology

Beta-sorted and zero-cost portfolios

The returns on the beta-sorted quintile portfolios are composed from the monthly stock return data from CRSP. At the end of June each year, stocks are sorted into quintile portfolios based on their past 60- and 36-month betas. Next, an equally weighted average return is calculated for the following 12 months. The returns on the beta-sorted portfolios are available from July 1984, because the monthly return data starts in July 1979 and 60 months are required to estimate betas. Average number of stocks and average beta of the stocks in each quintile portfolio are reported in Appendix A.

The returns on the levered and unlevered zero-cost beta portfolios (BL and BUL) are constructed from the lowest and highest beta portfolios. More specifically, the monthly return on the zero-cost portfolio is the monthly return on the lowest quintile portfolio minus the monthly return on the highest quintile portfolio. Furthermore, in the case of the levered portfolio (BL), both the highest and the lowest beta portfolio are leveraged to have a beta of one. Beta exposures of the lowest and highest beta quintiles are used to lever and de-lever the portfolios. Beta is the coefficient from a simple regression of the portfolio excess returns against the value weighted excess market returns. While the unlevered portfolio (BUL) has strong negative market exposure during the sample period, the levered portfolio (BL) is by construction market neutral. The formulas for the levered (BL) and unlevered (BUL) portfolios are as follows:

$$BUL = R_L - R_H, \quad (1)$$

$$BL = \frac{R_L - R_f}{B_L} - \frac{R_H - R_f}{B_H}. \quad (2)$$

Where BUL is the return on simple high-minus-low strategy in month t, BL is the return on the levered portfolio in month t. R_L and R_H are the returns on the lowest and the highest beta portfolios, respectively. B_L and B_H are the betas of the lowest and highest beta portfolios, respectively. Lastly, R_f is the risk-free rate.

Beta estimation

To sort stocks into equally weighted quintile portfolios an estimate of beta for each individual stock is required. The beta is the covariance of the excess return of a stock with the excess return of a value-weighted stock market index divided by the variance of the return of the value-weighted stock market index during the estimation period. The beta estimation period is either 60 or 36 months throughout this study. The beta estimate should reflect the actual beta during the period in which the returns are calculated. For instance, the lowest beta portfolio should include the quintile of stocks that has the lowest beta exposures during each 12-month period in which the returns are calculated. At the very least, there should be real differences between the ex-post beta exposures of the quintile portfolios. If betas are extremely time-varying or if the betas were measured with great inaccuracy, the estimates might be less useful. However, it is not believable that a lot of stocks would change their beta exposures a lot. Likewise, even if there were stocks with extremely time-varying betas, the portfolios' size is big enough. Moreover, the beta estimation period is long and as Bali and Cakici (2008) show for idiosyncratic volatility that the longer the estimation period the closer is, the more predicted and realized values are alike.

Factor-model regressions

So far market risk has been only considered but whether BAB phenomenon exists after controlling other variables known to explain the cross-section of stock returns. These variables are size, value, momentum, liquidity, and profitability. Specifically, the excess returns of the quintile portfolios and returns on zero-cost strategies are regressed on excess market return as well as three-, four-, and six-factor models including additional factor proxies for each of the five variables. Using the linear factor models provides a clear and direct measure to assay the abnormal performance of a portfolio or long-short strategy by focusing on the regression alpha. The dependent variable in all the models [(*3*), (*4*), (*5*), and (*6*)] is the excess return over risk-free rate of a beta-sorted quintile portfolio (B1, B2, B3, B4, and B5) or a zero-cost strategy (BL, BUL, and BAB). The explanatory variables are excess market return and returns on long-short strategies. Alpha is the intercept of the regression. In economic terms alpha implies return not explained by risk factors or factors known to explain the cross-section of stocks returns. The aim is simply to provide a benchmark against which to assess the returns of the beta-sorted portfolios and zero-cost strategies.

Capital asset pricing model (market) uses the sensitivity of a stock or portfolio to the market in explaining the returns. MRKT is the excess return on the market over the risk-free rate.

$$R_{jt} = \alpha_j + b_j MRKT_t + \varepsilon_t \quad (3)$$

Three-factor model (market, size, value) (Fama and Frech, 1993) includes factors for excess market return (MRKT), size (SMB), and value (HML). SMB is the return on small stocks minus the return on big stocks. HML is the return on high book-to-market stocks minus the return on low book-to-market stocks.

$$R_{jt} = \alpha_j + b_j MRKT_t + c_j SMB_t + d_j HML_t + \varepsilon_t \quad (4)$$

Four-factor model (market, size, value, momentum) (Carhart, 1997) is similar to the three-factor model but includes an additional variable for momentum (MOM). MOM is the return on the best-performing stocks minus the return on the worst-performing stocks over a period from t- 12 to t-2, where t is month.

$$R_{jt} = \alpha_j + b_j MRKT_t + c_j SMB_t + d_j HML_t + e_j MOM_t + \varepsilon_t \quad (5)$$

Six-factor model (market, size, value, momentum, liquidity, profitability) contains all the same factors as the four-factor model and adds two factors for liquidity and profitability. LIQ is the traded liquidity factor of Pastor and Stambaugh (2003). PMU is the return on the most profitable firms minus the return on the least profitable firms. Profitability is measured by gross profitability to assets.

$$R_{jt} = \alpha_j + b_j MRKT_t + c_j SMB_t + d_j HML_t + e_j MOM_t + f_j LIQ_t + g_j PMU_t + \varepsilon_t \quad (6)$$

2-3 Research Data

Monthly stocks return data is from Center for Research in Security Prices (CRSP). This covers all stocks in NYSE, Nasdaq, and Amex. The stocks with prices below $ 5 and above $ 1000 have been excluded because of adopting the conservative approach. The researchers use stock return data between 1984 and 2012 to sort stocks into quintile portfolios based on beta. Of note is that, the data have a wider time horizon but the researchers consider their overlap. Table 2 provides a detailed account of different data that were adopted.

Table 2. Data sources

Data	Time horizon	Source
Excess market return, size, value	July 1926 – May 2016	Kenneth French's website
Momentum	January 1927 - May 2016	Kenneth French's website
Liquidity	August 1962 – December 2015	Lubos Pastor's website
Profitability	July 1963 – December 2012	Robert Novy-Marx's website
Investor sentiment	July 1965 – September 2015	Jeffrey Wurgler's website

3 Results

In this section the authors study empirically whether the betting against beta exists in the U.S. stock market between 1984 and 2012. The question is viewed from two angles. First whether the anomaly exists on an absolute return basis is checked and secondly the returns are studied from a risk-adjusted perspective in order to consider whether BAB phenomenon exists after controlling other variables known to explain the cross-section of stock returns.

3-1 Absolute returns

In table 3 summary statistics of the quintile portfolios and zero-cost strategies from 1984 to 2012 is reported. B1-B5 are beta-sorted portfolios. Each year ends up in June. All sample stocks are sorted into ascending order based on previous 60 (Panel A) and 36 (Panel B) month betas with a value weighted market index. Secondly, the stocks are assigned to five portfolios so that each portfolio contains equal number of stocks. Lastly, an equally weighted average return is calculated for the next 12 months.
Arithmetic and geometric returns are the arithmetic and geometric average of the monthly returns over the sample period, respectively. Excess return is the arithmetic average return over the risk-free rate, volatility is the monthly standard deviation of the return, beta is the sensitivity of the portfolio to the value-weighted market portfolio during the sample period, and Sharpe is the arithmetic average excess return divided by volatility.

Table 3. Summary statistics of the quintile and zero-cost portfolios.

t-statistic is reported in the parenthesis. statistically significant values are Highlighted when deemed important (***, **, and * denote statistical significance at the 1 %, 5%, and 10 % levels)

Panel A: Portfolios sorted by previous 60 month beta							
	B1	B2	B3	B4	B5	BUL	BL
Arithmetic return	1.13	1.26	1.35	1.36	1.44	-0.31	1.07
Geometric return	1.09	1.18	1.24	1.22	1.21	-0.46	0.93
Excess return	0.78	0.91	1.00	1.01	1.09	-0.31 (-1.01)	1.07*** (3.69)
Volatility	2.79	3.95	4.75	5.29	6.79	5.51	5.21
Beta	0.42	0.75	0.94	1.07	1.37	-0.95	0.00
Sharpe	0.28	0.23	0.21	0.19	0.16	-0.06	0.20
Panel B: Portfolios sorted by previous 36 month beta							
	B1	B2	B3	B4	B5	BUL	BL
Arithmetic return	1.13	1.30	1.30	1.31	1.51	-0.38	0.83
Geometric return	1.08	1.23	1.19	1.17	1.28	-0.52	0.73
Excess return	0.78	0.95	0.95	0.96	1.16	-0.38 (-1.33)	0.83*** (3.33)
Volatility	2.86	3.87	4.64	5.31	6.72	5.18	4.48
Beta	0.46	0.74	0.92	1.08	1.36	-0.90	0.00
Sharpe	0.26	0.23	0.18	0.15	0.14	-0.07	0.18

While table 3 shows the monotonically increasing arithmetic returns and volatility in beta quintiles and flat geometric returns, it also shows that the return difference between the lowest and highest beta portfolio (BUL) has not been statistically significant. Panel A and B show that the return difference has been -0.31 % (t-value, -1.01) and -0.38 % (t-value, -1.33) per month using the 60 month and 36 month beta estimation period respectively. The result would be non-existent if we were to calculate the difference between the returns of, for example, B2 and B5 portfolios, because the lowest beta portfolio produces the worst returns.

3-2 Risk-adjusted returns

The aim in this subsection is whether or not the BAB exists on risk-adjusted basis. First we should consider whether Sharpe ratios and risk-parity portfolios reflect what would be expected. The returns on levered BL portfolio also provide evidence on the question. These portfolios are levered to have equal risk because standard finance theory suggests equal expected returns in this manner.

As shown in table 3 the low-beta portfolios provide very attractive risk-return features because Sharpe ratios are monotonically declining in beta. Using the 60 month beta-estimation period, Sharpe ratios decline from 0.28 to 0.16 (Panel A), and using the 36 month beta-estimation period they decline from 0.26 to 0.14 (Panel B). Monotonically decreasing Sharpe ratios mean that extra unit of volatility has not produced sufficient extra return. The Sharpe ratios in this paper correspond rather well to those in the previous literature being slightly higher on average and showing less extreme divergence between the quintile portfolios. For example, Frazzini and Pedersen (2014) report Sharpe ratios varying from 0.20 to 0.08 for lowest and highest beta decile, respectively.

Table4. Factor-model regression alphas.

The t-statisticis reported in parenthesis. Furthermore, statistically significant values are highlighted when deemed important (***, **, and * denote statistical significance at the 1 %, 5%, and 10 % levels).

All the figures are monthly values or calculated from monthly values. For example, the CAPM alpha of B1 portfolio is 0.31 % per month. In total, there are 324 monthly observations.

	CAPM (Eq. 3)	Three Factor (Eq.4)	Four Factor(Eq.5)	Six Factor(Eq.6)
Panel A: Beta-sorted portfolios				
B1	0.31*** (3.25)	**0.26*** (2.77)**	**0.19** (2.04)**	**0.25*** (2.62)**
B2	0.09 (1.49)	0.02 (0.45)	-0.04 (-0.78)	**-0.08* (-1.68)**
B3	0.00 (-0.06)	-0.05 (-1.24)	**-0.08* (-1.87)**	**-0.13*** (-2.97)**
B4	**-0.11** (-2.30)**	**-0.12** (-2.44)**	**-0.09* (-1.81)**	**-0.14*** (-2.76)**
B5	**-0.29** (-2.20)**	-0.10 (-1.11)	0.02 (0.21)	0.11 (1.13)
B1−B5	**0.60*** (3.70)**	**0.36*** (2.72)**	0.17 (1.31)	0.14 (1.05)
Panel B: Zero-cost portfolios				
BL	**1.07*** (3.65)**	**0.81*** (3.06)**	**0.64** (2.42)**	**0.69** (2.54)**
BAB	**1.00*** (4.86)**	**0.78*** (4.17)**	**0.56*** (3.13)**	**0.45** (2.41)**

Taking beta risk has not been rewarded. While beta of the B5 portfolio is over three times that of the B1 portfolio, the return is only slightly higher. Moreover, the returns on BL strategy should be zero. However, the monthly return on BL portfolio is positive and statistically significant being 1.07 % (t-value, 3.69) and 0.83 % (t-value, 3.33) using 60 and 36 month beta-estimation periods, respectively, supporting the notion that beta risk has not been adequately rewarded.

The returns of the quintile portfolios and zero-cost strategies against CAPM as well as three-, four-, and six-factor models are studied to see how BAB behaves relative to the most popular factors known to explain stock returns. Table 4 provides alphas of the multifactor-model regressions. It shows that the BAB exists on risk-adjusted basis. In Panel A, alphas are generally declining in beta. The relation is monotonically decreasing for portfolios from B1 to B4. B1 always outperforms the other four portfolios, B2 always outperforms B3 and B4, and B3 always outperforms B4. However, the highest beta portfolio actually performs relatively well on factor-model basis. B4 outperforms on three-factor basis, and B4, B3, and B2 on four and six-factor basis. More specifically, CAPM adjusted alphas are monotonically declining in beta and statistically significant for the B1, B4, and B5 portfolios. The difference of 0.60 % (t-value, 3.70) between CAPM alphas of the lowest and highest beta portfolio is similar to those reported in the previous studies. For example, Baker, Bradley, and Wurgler (2011) and Novy-Marx (2014) report alpha differences of 0.64 % and 0.50 %, respectively. Moreover, three-, four-, and six-factor alphas are monotonically declining between portfolios from B1 and B4, but B5 performs better than expected on three-, four-, and six-factor basis. It even produces positive alpha in four- and six-factor basis even though neither is statistically significant. Secondly, the alpha difference is positive for all the multifactor models varying from 0.36 % to 0.14 % for three- and six-factor models, respectively, but statistically significant only for the three-factor model (t-value, 2.72).

Panel B in table 4 shows the results for zero-cost portfolios and provides further evidence for BAB phenomenon. All the BL alphas are positive and statistically significant, t-statistics varying from 4.86 to 2.41. BL alpha drops from 1.07 % (CAPM) to 0.64 % (four factor model) and BAB alpha from 1.00 % (CAPM) to 0.45 % (six factor model) per month.

Table 4 shows the average monthly alphas from factor-model regressions from 1984 to 2012. Column 1 shows the dependent variables that are excess returns on the beta-sorted portfolios (Panel A) and zero-cost strategies (Panel B). B1-B5 are beta-sorted portfolios. Each year ends up in June. All sample stocks are sorted into ascending order based on previous 60 month betas with a value-weighted market index. Moreover, the stocks are assigned to five portfolios so that each portfolio contains equal number of stocks. Lastly, an equally weighted average return is calculated for the next

12 months. BL is the return on the lowest beta portfolio minus the return on the highest beta portfolio, where portfolios are levered or de-levered to have a beta of one. BAB factor is from Frazzini and Pedersen (2014).

4 Discussion

The results in Table 3 confirm the previous literature in which there is no robust link between beta and return. Average returns are fairly flat and the return on BUL portfolio is not statistically significant. However, there are a couple of interesting differences. First, Table 3 shows upward sloping beta-return relation which is demonstrated by the negative return on BUL portfolio whereas the difference has been previously positive (e.g. Baker, Bradley, and Wurgler, 2011; Novy-Marx, 2014b; Bali et al., 2014) or at least there has been a tilt towards the highest beta portfolio (e.g. Black et al., 1972; Frazzini and Pedersen, 2014). Thus, the relation has been closer to the expected in this sample. Secondly, the level of excess return has been higher between 1984 and 2012 than in the samples covering the period from 1960s until yearly 2000s. The level of excess returns in present study is closer to the ones reported in Black et al. (1972) and Frazzini and Pedersen (2014) who cover the longer period beginning from 1930s.
The finding of no link between beta and return in this context is not surprising because the authors exclude the most illiquid stocks, use equal-weighting in calculating the portfolio returns, longer estimation period for beta, and less frequent rebalancing, which all have tended to provide less impressive results for the betting against beta. These results also mean that the first hypothesis is rejected because there is no economically or statistically significant link between beta and absolute returns.
In terms of risk-adjusted basis, on the other hand, the result is somewhat in line with previous studies, as e.g. Bali et al. (2014) and Novy-Marx (2014) report four- and three-factor alphas of 0.51 % and 0.28 %, respectively. The more significant four-factor alpha in Bali et al. (2014) is the results of very bad performance of the highest beta decile in their study. Lastly, B5 performs relatively well on a multifactor-model basis, and when the authors compare multifactor-model alpha differences between B1 and B4 portfolios the differences are highly statistically significant, t-values varying from 3.94 to 2.65 (not reported). The results strongly suggest that BAB exists on risk-adjusted basis.
Overall the results in this context indicate that the BAB phenomenon exists in the U.S. stock market on risk-adjusted basis and the hypothesis two is not rejected. Monotonically declining Sharpe ratios and CAPM alphas all highlight the fact that taking beta risk has not produced enough, if any, extra return. Moreover, the lowest beta portfolio produces statistically significant alpha even after controlling with size, value, momentum, liquidity, and profitability factors known to explain the cross-section of stock returns well.
Some ambiguity is still left as it is not the case that high beta stock does extremely badly when controlling with these other factors and alphas are not entirely monotonically decreasing in beta using the multi-factor models. The high monthly returns of strategies (BL, BAB) taking advantage of the attractive risk-return features of the low beta portfolios, however, by leveraging them up it provides strong support for the BAB phenomenon. Moreover, these strategies provide robustly positive and statistically significant alpha after controlling with size, value, momentum, liquidity, and profitability factors.

5 Conclusion

This paper demonstrates that BAB phenomenon is robust in the U.S. stock market. Despite the conservative empirical setting of the study, the results support empirical findings of the previous studies that low beta stocks earn better than expected returns and high beta stocks earn worse than expected returns. On absolute return basis no significant differences in the returns of beta-sorted portfolios were found. The return on a simple lowest minus highest beta quintile portfolio was also statistically indistinguishable from zero.
Furthermore, the low beta stocks outperform high beta stocks on risk-adjusted basis. Sharpe ratios and CAPM regression alphas are declining in beta and a long-short portfolio conceptually similar to BAB factor (Frazzini and Pedersen, 2014) produces positive and statistically significant returns during the sample period. Finally, BAB was robust in conservative approach after controlling with variables known to explain cross-sectional stock returns (e.g. size, value, and momentum). These findings give some highlights into the study of BAB phenomenon.
The main contribution of this study is providing a propitious perspective for investors that help them to make more lucrative decision via identifying the kernel of BAB phenomenon in the stock market in order to decrease the risk of their investment; whereas, the application of the results beyond stock markets should be done cautiously. Currently, there are multiple explanations for BAB while they can all have a role to play, their importance can vary across different markets. Thus, an obvious extension of present study is to investigate whether BAB phenomenon exists in other markets and under different circumstances.

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Appendix

A1. Yearly number of stocks in the quintile portfolios

This table shows the number of stocks in each quintile portfolio for each year. The years are not calendar years. Year 1984 corresponds to a period from July 1984 to June 1985, etc. B1-B5 are beta-sorted portfolios. All sample stocks are sorted into ascending order based on previous 60 month betas with a value-weighted market index. Secondly, the stocks are assigned to five portfolios so that each portfolio contains equal number of stocks. Lastly, an equally weighted average return is calculated for the next 12 months.

	B1	B2	B3	B4	B5
1984	188	187	188	185	187
1985	184	183	182	181	182
1986	178	178	180	175	177
1987	179	176	178	177	177
1988	201	199	200	199	198
1989	218	217	214	215	215
1990	230	229	228	231	227
1991	241	241	239	238	239
1992	250	248	254	260	261
1993	293	257	273	258	277
1994	326	264	277	269	293
1995	305	305	302	304	304
1996	334	334	333	332	333
1997	370	368	370	368	368
1998	385	382	384	388	377
1999	392	392	388	391	388
2000	385	385	384	384	384
2001	395	395	393	396	392
2002	395	398	393	394	390
2003	425	422	428	421	421
2004	445	439	440	441	440
2005	461	456	456	457	457
2006	474	474	472	472	472
2007	466	465	464	463	464
2008	435	434	435	433	432
2009	466	463	463	465	461
2010	485	486	483	481	483
2011	488	497	481	465	483

A2. Average betas of the stocks in the quintile portfolios.

This table shows the average beta of a quintile portfolio. B1-B5 are beta-sorted portfolios. Each year ends up in June. All sample stocks are sorted into ascending order based on previous 60 month betas with a value-weighted market index. Secondly, the stocks are assigned to five portfolios so that each portfolio contains equal number of stocks. Lastly, an equally weighted average return is calculated for the next 12 months. The average betas of the quintile portfolios show larger variation that the actual betas of the portfolios. This result is familiar from Blume (1975) who show that betas regress toward mean even after controlling for the "order bias".

	B1	B2	B3	B4	B5
1984	0.42	0.81	1.04	1.29	1.73
1985	0.34	0.77	1.02	1.26	1.75
1986	0.49	0.81	1.05	1.25	1.67
1987	0.47	0.78	1.02	1.24	1.63
1988	0.45	0.87	1.06	1.25	1.56
1989	0.47	0.86	1.06	1.23	1.54
1990	0.49	0.83	1.02	1.19	1.48
1991	0.46	0.85	1.06	1.24	1.59
1992	0.41	0.81	1.05	1.25	1.61
1993	0.34	0.75	1.02	1.28	1.77
1994	0.37	0.77	1.03	1.28	1.78
1995	0.32	0.71	1.01	1.30	1.87
1996	0.24	0.59	0.88	1.18	1.85
1997	0.27	0.58	0.84	1.12	1.78
1998	0.24	0.55	0.80	1.06	1.61
1999	0.16	0.57	0.85	1.11	1.65
2000	0.08	0.47	0.77	1.03	1.63
2001	0.05	0.34	0.61	0.89	1.63
2002	0.02	0.31	0.57	0.88	1.65
2003	0.03	0.33	0.59	0.94	1.78
2004	-0.03	0.24	0.51	0.90	1.83
2005	0.03	0.34	0.63	1.00	1.92
2006	0.07	0.48	0.80	1.13	1.93
2007	0.10	0.55	0.85	1.17	1.91
2008	0.25	0.73	1.02	1.31	1.93
2009	0.31	0.73	1.04	1.33	1.89
2010	0.33	0.73	1.01	1.29	1.82
Average	0.27	0.64	0.90	1.16	1.73