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CITY UNIVERSITY RESEARCH JOURNAL
Vol (10), No. (1)

Does Pakistan Stock Exchange Pay to Bet Against the Beta?

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Keywords:

Low Beta Anomaly, Market Efficiency, Asset Pricing, CAPM, Alpha

ABSTRACT

Beta anomaly is regarded as the most puzzling phenomenon in the history of finance as it represents the basic notion that a higher return can only be earned after taking more risk. This study conducts inquiries into the presence of the low beta anomaly in Pakistan Stock Exchange (PSX) after controlling for size and value, through the construction of an arbitrage portfolio by taking a long and short position on beta-sorted stocks. For this purpose, the study uses the monthly data of all stocks listed on PSX those having data range from June 2001 to June 2017. Fama-Macbeth methodology is used to derive the risk and returns relation by estimating beta on a 36-months rolling window. Initial testing of CAPM indicates a positive and significant relation between systematic risk and return. Further results reveal the presence of the low beta anomaly, as the lowest portfolio sorted by beta earns high average annualized return than the highest beta-sorted portfolio. The difference between this low-high beta-sorted annualized return is 6.4%. The performance of beta sorted portfolio is also compared with the Sharpe ratio. Results reveal that a low beta-sorted portfolio reports a higher Sharpe ratio as compared with a high beta-sorted portfolio. The arbitrage portfolio reports significant difference in returns in comparison with other quartiles portfolios. Arbitrage portfolio is also sub-divided on the basis of the holding period yield and reveals that it out-performed other portfolios during the reported period of 2003 to 2009. Based on these results, investors may devise their portfolio strategies by considering this anomaly till risk-return relation reverts to equilibrium.

INTRODUCTION

Theories of investment always dictate that higher risks are compensated by higher returns. However, this notion is proved false after the emergence of vast literature on the low beta anomaly (Abdollahi et al., 2016; Baker & Haugen, 2012; Barroso, 2016; Collver et al., 2013; Li et al., 2016; Stambaugh et al., 2012; ZHANG, 2005), which has gained much attention from researchers in recent years, though, the phenomenon can be traced back to Black, Jensen, & Scholes (1972). According to the low beta anomaly, stocks with low beta earn higher average risk adjusted returns as compared to the stocks with higher beta. This phenomenon is not limited to a specific emerging market or developed market; literature can be traced from developed market of US and other developed international markets to emerging markets of Asia (Ang *et al.*, 2006, 2009; Chow *et al.*, 2014; Kochard & Sullivan, 2014). Beta anomaly is considered as one of the most prominent anomalies till today (Joshipura & Joshipura, 2015). This anomaly is considered the most puzzling one as it challenges the traditional asset pricing theories. Common sense, as well as all these theories, state that the extra return is only earned by taking extra risk. However, in accordance with the beta anomaly, high beta stocks earn negative abnormal returns while low beta stocks earn positive abnormal returns (Baker & Haugen, 2012). This anomaly is

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particularly intriguing because it is clearly against the true spirit of the classic CAPM (Buchner & Wagner, 2016).

Significance and **Research Gap**

The aim of this study is three-fold: the basic purpose is to re-validate the traditional risk and return relation in the stock market; secondly, to explore the presence of a low beta anomaly in an emerging market i.e. Pakistan, and lastly, to check the validity of "Betting against Beta" (BAB) strategy to earn abnormal profit in PSX. Contextually, no study can be traced on these phenomena on the PSX. Although Baker et al., (2016); Blitz et al., (2013) and Jarrow et al., (2020) indicate the presence of a low beta anomaly in emerging markets, but their sample does not include Pakistan. This work is an effort to enhance the understating of the market participants about the beta anomaly and provide empirical guidance about BAB as an investment strategy in Pakistan. The study answers three important questions in this area of research; 1) Does traditional CAPM hold in Pakistan's market? 2) Does beta anomaly exist in PSX? 3) Does there exist an arbitrage profit in betting against the beta strategy? This work fills the gap in the existing literature as less work is available on emerging markets, whereas evidence from Pakistan is essentially missing.

Brief History of Pakistan Stock Exchange

The Pakistan Stock Exchange (PSX), previously known as Karachi Stock Exchange (KSE), was established in 1949 as a company limited by guarantee. The other exchanges in Pakistan i.e. the Lahore Stock Exchange (LSE) and the Islamabad Stock Exchange (ISE) were established in 1974 and 1997 respectively. These markets had no mutual links in term of management, trading, indexes, listing etc. which creates difficulty for the investors. Therefore, Government of Pakistan integrated these markets by Demutualization Act 2012 and as a result PSX started its operation from year 2016. KSE-100 index is a popular index which is a weighted average market capitalization index of 100 companies, where 34 companies are selected from each 34 sectors and the remaining 66 firms are selected without consideration of the sector but high market capitalization. PSX is a volatile markets as other emerging stock market (Iqbal, 2012).

LITERATURE REVIEW

According to the traditional CAPM, beta (a measure of systematic risk) is the only measure of expected return, and market portfolio is the only portfolio that provides maximum excess return per unit of risk (Lintner, 1965; Mossin, 1966; Sharpe, 1964). In portfolio theory, risk averse investor prefers to invest in a combination of the market portfolio by taking long position in it while using t-bill as a risk-free asset by taking long or short position to meet his unique risk-return preferences. So in such situation an investor who wants higher return uses unlimited borrowing at risk free rate to leverage his portfolio. This strategy increases the risk level of the investor and thus increases the expected returns (Estrada, 2002). In the real world, however, under constrained borrowings an investor tends to exhibit preference for investing in high beta stocks than the market portfolio in an anticipation to beat the benchmark

(market) portfolio. Are such investors rewarded for the extra risk taken, as claimed by the traditional CAPM?; there is no satisfactory answer to this question yet as proponents of the beta anomaly have more evidence to reject this claim (Joshipura & Joshipura, 2015).

The phenomenon of the low beta anomaly can be traced back to the 1970s, when Black (1972) and Black, Jensen, & Scholes (1972) first reported that the relation between risk and return is much flat than what the traditional CAPM actually claims. These studies argued that this difference is due to the problem of constrained borrowings in the real world. Haugen and Heins (1975) conclude that in the long run, the stocks with lower variance in the monthly returns have earned a greater average return than stocks with higher variance. However, at that time, academician and practitioners both believe more on the market efficiency and validity of CAPM and thus, the results are considered dubious because of data mining, and data snooping.

The beta anomaly is large, persistent, and a global phenomenon (Frazzini & Pedersen, 2014; Joshipura & Joshipura, 2017). There are many other close forms of the low beta anomaly like total volatility (Baker *et al.*, 2011); low risk anomaly (Asness *et al.*, 2014), and residual volatility (Ang *et al.*, 2006, 2009). Black (1993) states that there is high correlation between the total risk and the residual risk, therefore, the beta factor might be better called as the total risk factor or the residual factor. In the recent literature, different investment strategies are reported to have earned arbitrage profit using low beta anomaly. One such commonly used strategy is BAB by Frazzini & Pedersen (2011, 2014) which constructs an arbitrage portfolio by going long on low beta stocks and short on high beta stocks. Their BAB factor predicts significant positive risk adjusted returns and has higher Sharpe ratio than the Black (1972) zero beta portfolio. Their studies explain that the low beta anomaly can easily be understood by taking into account this BAB factor. The literature also exhibits that investing through the low beta anomaly provides the investors an alternative source in the form of equity return premium. Baker *et al.* (2011) theorize that the low beta anomaly can be explained by the constrained leverage phenomenon i.e. Black (1972) zero beta portfolio or gambling phenomenon i.e. Barberis and Huang (2008). Although, some proponents like Cederburg and O'Doherty (2016) suggest using this BAB portfolio with much caution; a statistically significant difference in the low and high beta anomaly may be due to the individual biases in the unconditional performance measures.

METHODOLOGY

The monthly stock returns of all available stocks and the market, are calculated by using the formula $R_t = \ln\left(\frac{p_t}{p_{t-1}}\right)$. Prices are adjusted for the dividend payments, however the adjustment of right and bonus share is not incorporated. For the market return monthly KSE 100 index value is used. The study applies to Fama-Macbath's (1973) cross sectional regressions on the recommendation of Cederburg and O'Doherty (2016) to test the basic risk and return relation between expected return and systematic risk i.e. beta. Fama-Macbeth (1973) model takes place in two-step estimation: in the first step, betas are estimated in time series regression while in the second step, the expected returns are regressed against the estimated betas from the first equation.

$$R_{it} - R_{ft} = \alpha_o + \beta_o (R_{mt} - R_{ft}) + \varepsilon_{i,t} \quad \text{(Eqs.1)}$$

$$R_i - R_f = \lambda_o + \lambda_m \widehat{\beta_{Pi}} + \mu_i \quad \text{(Eqs.2)}$$

where in equations (1 and 2) the dependent variable is $R_{it} - R_{ft}$, that excess return of stock i at time t and the independent variable is the excess market return in equation 1 and independent variable in equation 2 is the estimated beta for the each stock in portfolio. If the CAPM holds, than λ_o should not be significantly different from zero and λ_m should approximate the (time average) equity market risk premium, $(R_m - R_f)$.

The existence of the low beta anomaly is tested with the help of graphical and the regression methods. In the first method, returns of beta sorted portfolios are graphically displayed over time. If the returns of low beta portfolio are higher than the returns of higher beta portfolio, on consistent basis, then the existence of the low beta anomaly is validated. In later case, each beta-sorted portfolio returns are regressed against the excess market return and the alpha (regression constant) and beta (slope) values are obtained. If the alpha value decreases from the low beta sorted portfolio to the high beta sorted portfolio, then the low beta anomaly exists (Joshipura & Joshipura, 2015). In the current study both methods are used and their respective results are reported in data analysis section.

This study also constructs beta arbitrage portfolio by using Frazzini, and Pedersen (2014) by going long on the lowest beta quantile and going short on highest beta sorted portfolio after adjustment of high and low beta respectively.

$$r_{BAB,t+1} = \frac{r_{L,t+1} - r_{f,t+1}}{\beta_{L,t}} - \frac{r_{H,t+1} - r_{f,t+1}}{\beta_{H,t}} \quad \text{(Eqs.3)}$$

where $r_{L,t+1}$ is the return of lower beta stocks in a portfolio while $r_{H,t+1}$ is the return of higher beta stocks in a portfolio. The betas of these portfolios are denoted with $\beta_{L,t}$and $\beta_{H,t}$, where $\beta_{L,t} < \beta_{H,t}$.

Monthly data are downloaded from DataStream after adjustment for dividends, for the sample period running from June 2000 to June 2017. The KSE-100 index is used as the proxy of market portfolio and the three-month t-bill rate is used as a proxy for the risk-free rate. Following the methodology of Baker *et al.*, (2011); Kochard & Sullivan (2014); and Li, Sullivan, & Garcia-Feijóo (2014), the study focuses on the large capitalization stocks only. The major reason for taking only the large capitalization stocks is that the implementation of the low beta anomaly may require frequent rebalancing (Li, Sullivan, & Garcia-Feijóo, 2014).

Analysis

As mentioned above, in the first phase, the data are divided into two quantiles based on the market capitalization and the large cap companies are retained for further analysis on the recommendations of Baker *et al.* (2011). Then, for each month, stocks are sorted into five quantiles on the basis of systematic risk (β) where beta is calculated on a 36-month rolling regression using CAPM (market model) as followed by Baker *et al*. (2011). The results obtained by Fama-Macbeth (1973) are reported in Table 1.

Table 1: *Fama-Macbath Regression Results*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
λ_o	-.004	.001	-4.550	.019
Beta	.007	.002	4.327	.022
Adj R-squared	.472			
F-statistic	10.70			

The results indicate that the CAPM holds for the recent data of Pakistan, but not in the true spirit. This is evident from the fact that the independent variable beta is statistically significant and positive with a slope of .007. However, the constant is also statistically significant which indicates that market premium alone is not sufficient to explain variations in stocks returns rather there are other factor(s) too. The value of adjusted R^2 is .472, which indicates that 47.2% variation in the beta-sorted portfolios returns is explained by the market premium, whereas the remaining variation is due to other factor(s).

Figure 1 shows the average monthly returns of the five beta-sorted portfolios, including 20% of the sample stocks in each portfolio based on 36-month prior beta from 2003M6 to 2017M6. High and low beta portfolios are formed based on the monthly quintile break to assign each stock to one of the five portfolios based on the value of the beta after controlling for size. At the initial phase, all stocks are divided into two portfolios on the basis of size, then only large size portfolio is selected for further forming of five beta-sorted portfolios.

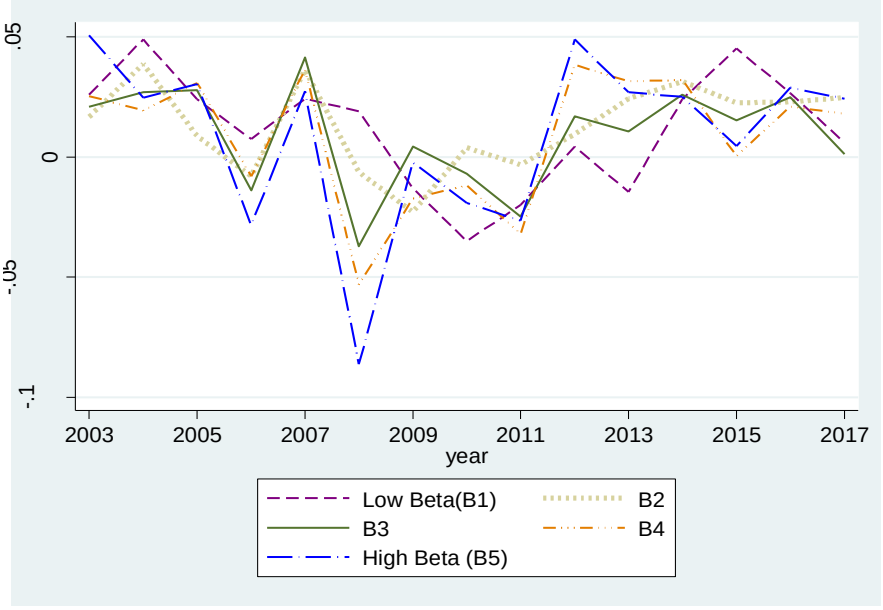

Fig. 1: *Average Returns of five portfolios formed on prior 36-months betas*

The lowest beta-sorted portfolio (B1) has higher monthly return while at the same time highest beta-sorted portfolio (B5) has lower monthly return. This inverse pattern can be traced throughout the entire sample period with some minor exceptions. The monthly returns of B2, another lower beta-sorted portfolio, are also higher than the high beta-sorted portfolios. The opposite positioning by these portfolios is nullified after almost every two years and then this pattern begins again. These patterns

show that the arbitrage process is actively working; the opportunities are realized, the patterns disappear, and then the cycle repeats again. The highest down trend can be seen in 2008 which is the year of a major stock market fall by almost 55% in just four months, and the stock market was frozen at the level of 9144 points for 108 days.

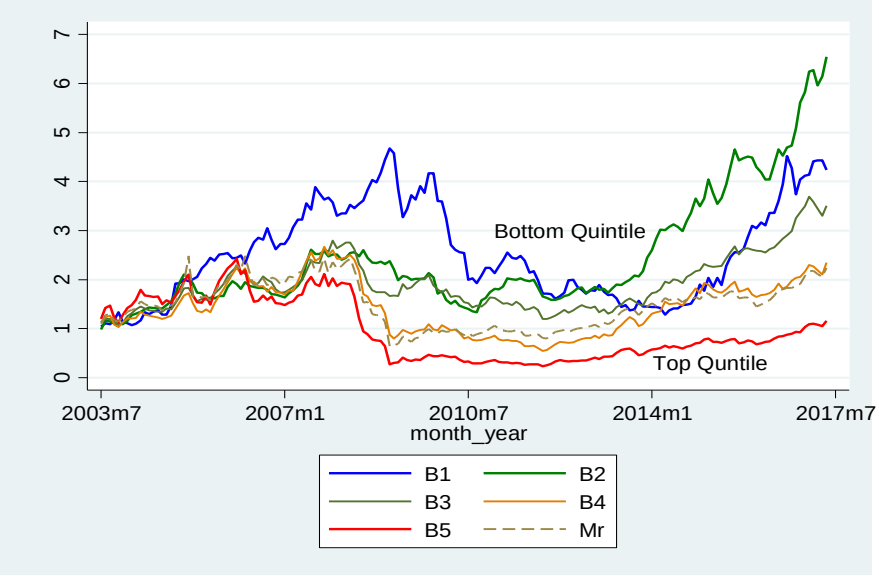

Fig. 2: *Cumulative returns for five portfolios formed on prior 36-months betas*

Figure 2 shows the cumulative holding periods yield for five beta sorted portfolios of PSX from 2003 to 2017. The low beta-sorted portfolios (B2 & B1) is delivering higher average holding period yield than any other portfolio which starts from Re. 1 investment and results in almost Rs. 6.23 and Rs. 4.3, respectively, after 14 years of holding, while Re. 1 invested in the high beta-sorted portfolios (B4 & B5) only grows to a highest value of Rs. 2.14 and ends on Rs. 1.21. This behavior of the market clearly indicates the presence of a low beta anomaly in PSX.

Both the low beta portfolios, B1 and B2, outperformed the high beta portfolios, while the high beta portfolio B5 shows the lowest cumulative average yield over the period. These results indicate the existence of the low beta anomaly in the PSX.

In the third phase of data analysis, for each beta sorted portfolio, the average return, standard deviation, ex-post beta, single factor alpha and Sharpe ratio for the time series of quintile portfolios over the entire study period are reported in table 2.

Table 2: *Regression Analysis of Beta Sorted Portfolios and BAB factor with Excess Market Return*

VARIABLES	Beta-1	Beta2	Beta-3	Beta-4	Beta-5	BAB
EMR	-.183***	.234***	.403***	.719***	.892***	1.272***
	(.069)	(.048)	(.038)	(.041)	(.049)	(.080)
Alpha	.013**	.011***	.006*	.002	.002	.016**
	(.005)	(.004)	(.003)	(.003)	(.004)	(.007)
R-squared	.041	.122	.398	.651	.786	.602
F-test	7.017	22.95	109.2	307.8	322.4	249.4
Prob > F	.009	.000	.000	.000	.000	.000

Mean Return	.144	.164	.111	.097	.080	.077
S.E	.252	.187	.178	.248	.342	.325
Sharp Ratio	.571	.876	.626	.392	.235	.238

Standard errors in parentheses
*** p<.01, ** p<.05, * p<.1

Table 2 reports the results of the excess market return of five beta-sorted portfolios. To construct the BAB factor, the difference between the monthly return of high and low beta portfolios is taken after adjustment for the time lag. The beta and alpha are, respectively, the slope and intercept of the regression line. Mean value of portfolio returns, volatility and Sharpe ratios are reported annually. The average beta of the regression rises successively in higher quintiles starting from -.182 for B1 to .892 for B5, while the alpha is decreasing from low beta portfolio i.e. .013 to high beta portfolio i.e. .002. This shows the presence of a negative relation between the risk and return, and hence confirms the presence of a low beta anomaly in this market. These results are consistent with Black (1972); the alphas decline from the low-beta to high-beta portfolios. Moreover, the Sharpe ratios declined from the low-beta to high-beta portfolios as well.

All the results are statistically significant for beta, while the alpha is only significant for low beta-sorted portfolios and insignificant for high beta-sorted portfolios. R-squared values have shown an increasing trend from low beta to high beta-sorted portfolios, while the mean returns are having a decreasing trend with a minor exception from B1 to B2. The values of Sharpe ratio show that the low beta-sorted portfolios have a higher Sharpe ratio than the high beta-sorted portfolios, again with a minor exception from B1 to B2.

The rightmost column of Table 2 reports the returns of BAB factor, i.e. a portfolio that is long on low-beta stocks and short on high-beta stocks as constructed by Frazzini, and Pedersen (2014). This arbitrage portfolio (BAB) of Frazzini and Pedersen (2014) perform well during this time period in PSX. These results indicate that there is positive and significant relationship between BAB factor and expected return. It means that one can earn arbitrage profit of 7.7% by going long on low beta stocks and short on high beta stock, and this relationship remain significant with 60% explanatory power. Although sharp ratio of this factor is low than other risk factors.

The study further extended the arbitrage portfolio into different periods to see the holding period yield on the BAB factor. Table 3 reports the regression results of the BAB factors over the excess market premium over different periods of time. The results indicate that holding arbitrage portfolio for different periods gives significant risk adjusted abnormal returns, where the alpha and the Sharpe ratio for the holding period of six years are more than the other investment horizons.

Table 3: *Holding Period Returns over the Years*

	One to 3 Years	One to 6 Years	One to 9 years	One to 12 years	One to 15 years
VARIABLES	BAB	BAB	BAB	BAB	BAB
EMR	.572***	.865***	.868***	.873***	.855***
	(.116)	(.079)	(.073)	(.065)	(.062)
Constant	.014	.019**	.013*	.013**	.013***
	(.012)	(.009)	(.007)	(.006)	(.005)
R-squared	.416	.630	.573	.557	.537

Mean	.013	.217	.115	.084	.078
Stdv	.322	.413	.377	.345	.325
Sharpe Ratio	.040	.526	.305	.242	.239

Standard errors in parentheses

*** p<.01, ** p<.05, * p<.1

These results are in accordance with the results of Baker *et al.* (2011). One of the possible explanations for existence of low beta anomaly in Pakistan may be that investors overweigh high-beta stocks to gain extra return due to the high use of leverage in the form of short selling. Due to this, the demand for high beta stock increases and returns decrease, and vice versa. Another possible reason may be the frequency of buying high-beta stocks than low-beta stocks may shrink their investment, when transection cost remains constant. In contrast, the study results differ from Frazzini and Pedersen (2014) as the beta sorted arbitrage portfolio underperforms than other beta-sorted portfolios. The possible reasons may be the actions arbitrating by institutional investor in PSX.

CONCLUSION

The findings of this study provide evidence for a low risk anomaly in PSX. In putting study results together, an interesting picture emerges. The performance of the low risk portfolio has outperformed the higher risk portfolios. The low-beta portfolio reports a positive alpha and the high-beta portfolio appears to have a negative alpha. The beta anomaly is robust after controlling for size. In this selected sample period of 14 years, a one-rupee investment at the start earns more than 600% in the low beta sorted portfolio whereas only almost 200% is earned in the high beta sorted portfolio. This study also constructs beta sorted arbitrage investment strategy and concludes that this strategy offers mixed results in different horizons. These results warn investors and brokers to use these investment strategies with much care. One of the practical implications of this study may be that the construction of the low risk beta strategies is influenced by the time varying factors. So, the investor should take great care of dealing with the construction of low risk investment strategy in Pakistan's equity market. Study is limited on testing the beta anomaly through traditional CAPM, but the same anomaly can be tested under multifactor CAPM framework like Fama & French (1992) three factor model, and alike others. Perold (2004) study indicates that such multifactor models use factors like size and value which cannot be term risk at all, so such models have limited applications. Although future work can be done on other multifactor CAPM model like hybrid CAPM etc. to test the beta anomaly with more stocks markets and long range data.

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