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The Myth of Downside Risk Based Capital Asset Pricing Model: Empirical Evidence from South Asian Countries

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Abstract *The study aims to empirically investigate the applicability of the downside risk based Capital Asset Pricing Model (CAPM) for four south Asian countries e.g. Bangladesh, India, Pakistan and Sri Lanka. Fama-MacBeth methodology is used for monthly data from January 2007 to December 2017. The results partially supported the predictors of the model for all the four equity markets and can be concluded that the downside risk based CAPM better suits the emerging equity markets. All market players may be benefited with the results concluded in the study. The region have large similarities and the setup of the equity markets is also quite identical, making them suitable for an integrated stock market.*

Key Words:
Downside Risk, CAPM, Fama-MacBeth, PSE, BSE, CSE, DSE

JEL Classification:
G10, G12

Introduction

Theory of modern finance has two main focuses; time value of money and risk management. Both are quite comprehensive and they contain extensive contribution to the study. One of the important topic of risk management is pricing the assets i.e. asset pricing. The importance of asset pricing and the consequent concentration of researchers, academicians and professionals is being indicated by the literature on the asset pricing model (Roy, 1952; Sharpe, 1964; Merton, 1973; Fama and French, 1994, 1995, 1996, 2000, 2002; Estrada, 2002). There are several models for this specific objective but most prominent one is the Capital Asset Pricing Model (CAPM), which states that there is a liner relationship between returns and risk of an asset. CAPM has its roots from Markowitz (1952) theory of finance. Sharpe (1964) and Lintner (1966) have been credited to develop the initial version of CAPM. The research on the empirical validity as well as on the underlying assumptions of the model continue from several years. In between

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traditional model has faced several criticisms, when it comes to the empirical applicability of the model, but still due to its simplicity and acceptability it is considered the most valuable, asset pricing model.

Different versions and factors of CAPM have been introduced in the standard model and put into empirical tests as traditional CAPM faced several denunciations; one of them is the down side risk-based CAPM, which states that investor is more concerned about his down side risk and measures the "minimum acceptable return". Pioneer concept of downside risk measure is presented by Roy (1952), according to him investor would have a rational approach by insuring the investment principle of "minimum acceptable return". He argued that investor would accept the investment having the lowest probability of being lower than the minimum acceptable return. Markowitz (1959) latterly argued that investors are more concerned about the risk of loss and the unusual return. Therefore, he advocated the use of downside risk measure for portfolio decision making. He further suggested that a downside measure of risk can be done in two ways; a semi-variance measure which is being calculated from below the mean deviations and a semi-variance measure which is calculated from form below the targeted return deviations. He showed that when returns on assets are non-normal than downside risk measure is a better one.

Traditional Sharpe (1964) and Lintner (1966) CAPM follow the mean variance (MV) framework. One of the important assumptions of CAPM is that the investor has a unique quadratic utility function. To improve this utility function assumption, Bawa (1975) proposed the LMPM. Human behavior is perceived as an aversion to loss rather than risk, and following the MLPM framework, investors should follow more than one utilitarian function of Von Neuman-Morgenstern more consistent and more effective in observing the human behavior. Harlow and Rao (1989) then extended the MLPM framework to the general framework of generalized GMLPM medium and argued that the earlier work of Hogan and Warren (1974), Bawa and Lindenberg (1977), and Sharpe models of Lintner were taken into account as special cases of the GMLPM framework.

The present study focuses on downside risk-based CAPM (D-CAPM) for the selected South Asian countries, the selected countries are Bangladesh, India, Sri Lanka and Pakistan, as empirical failure (Iqbal and Brooks, 2006; Javid and Ahmed, 2008; Choudhry and Choudhry, 2010; Shaikh, 2012; Rizwan *et.al,* 2013; Yasmeen. *et.al,* 2015; Shah *et. al,* 2015; Alam *et. al,* 2015; Molik and Bopari, 2015; Bajpai and Sharma, 2015) of traditional CAPM and its variant have been observed mostly in the developing and immature stock markets, the sample countries fall in the said category, the selected stock markets have quite similar setup and as SAARCFINANCE is a specific division in the South Asian Association for Regional Cooperation (SAARC) which have objectives like to open dialogues on macroeconomic policies and sharing experiences regarding stock markets and other financial institutions therefore, this paper is useful

contribution as far as the returns of the common stocks in the equity markets is concerned, the selection of these four countries have been made because all these four stock markets carries more than 75 percent market capitalization in the region (wfe;ADB, 2017), keeping in view the investors focus of minimum acceptable rewards of investment i.e. Downside CAPM (D-CAPM).

The results of the study advocated that D-CAPM is a better measure since investors are more concerned for the minimum acceptable reward for their investments. The investor's behaviour in the developing stock markets is different than that of developed and mature ones, here investors are more concerned for their losses as compare to that of upward biased of the returns. Very few studies have been found about empirical applicability of D-CAPM in the region. Therefore, the aim of this study is to investigate the empirical validity of the D-CAPM. The study has been organized to achieve the set objectives e.g. To determine that whether D-CAPM can explain the variations in the stock returns of the developing economies of SAARC nations and whether to see that D-CAPM is really the one which is useful for investors to make their investment decisions. The study particularly answers subsequent research questions to meet the set objectives: Is D-CAPM the one which is better able to elucidate the stock earnings, discrepancies in the developing equity markets of selected south Asian countries? Do investors are really concerned about their minimum acceptable returns?

Literature Review

It is now more than five decades ago that the CAPM was first discussed by Sharpe (1964) and Lintner (1966). During this period, this theory was still attractive to researchers and academics, both theoretically and empirically. All these efforts ultimately resulted in modified versions of the traditional CAPM to meet CAPM's criticism and the underlying assumptions. Since this study is specifically about the empirical investigation of D-CAPM so we have discussed the relevant literature.

Bawa and Lindenberg (1977) are among the pioneers as far the empirical testing of D-CAPM is concerned. Their core findings were in favour of MLPM framework then Mean-Variance (MV) framework. Price *et al* (1982) used data of US equity market started from 1927 to 1968 and came up with the conclusion that semi-variance framework better predicts the returns as compare to that of variance because variance based CAPM overestimates the risk of high betas whereas underestimates the risk of lower betas. They It was assumed that there is a positive relationship between expected returns and downside risks. Harlow and Rao (1989) have been credited with providing a downside risk measure using the MLPM frame that measures up and down. He further concluded that downside beta is a better measure than traditional CAPM. Harlow (1991) provided empirical support for MLPM framework. Ahmed and Zaman (1999) conducted a study to empirically support the CAPM by using GARCH-M model and concluded that there is strong

volatility in the stock returns at Karachi Stock Exchange (KSE). Harvey and Siddique (2000) also have found no significance. One of the pioneer study in the area of downside risk measures and its framework is of Estrada (2000) he supported and empirically proved the downside CAPM (D-CAPM) by introducing the mean-semi variance behaviour of the distribution. Another notable study conducted by Ang *et al* (2001) investigating the explanatory effect of CAPM's downside risk using monthly stock returns of US stocks that took data from January 1964 to December 1999. They concluded that the return was partly explained by the negative exposure risk. Estrada (2002) also supported the average semi-Albanian behavior of D-CAPM. Ang et al (2006) has concluded that downside risk premiums are 6% and that heavily correlated shares during downturn have a high return. Olmo (2007) extracted the results in favour of D-CAPM they used Mean-variance-downside-risk (MVDR). He compared the results of CAPM and D-CAPM and proved statistical significant of the model. Artavanis *et al* (2010) also came up with the results in support of D-CAPM. They used data of the stocks of UK and France. Akbar *et al* (2012) put Karachi Stock Exchange (KSE) under study for D-CAPM and concluded that this model is a better measure as compare to that of traditional model especially in case of developing equity markets.

The alternative framework of CAPM i.e. downside risk based CAPM based on the assumption of mean-semi variance (MSB) behaviour. In this framework investors put more weight to the returns below a targeted return.

Review of literature suggests that very few studies in this direction put the test for South Asian countries as the explanatory force of downward risk-based CAPM in international markets (Estrada, 2002; Olmo, 2007) urged us to take action in this direction. Current study adds to the existing literature on downside risk-based asset pricing models in connection with new equity markets in South Asia. In the present study, we tried to investigate the pragmatic validity of D-CAPM.

Data and Methodology

Theoretical Framework

The investors are anxious about the downturn risk and one of the underlying assumption of the CAPM is that investor has a single quadratic utility function, Bawa (1975) proposed the mean lower partial moment framework (MLPM) framework, which provides the basis for the current state of D-CAPM.

Now, if we want to simply see the Capital Market Line (CML) in case of Bawa and Lindenberg (1979) and want to produce the two fund separation theorem graphically then it is shown below in figure 1, which shows that liner combination of the risk free assets and risky assets must be a tangent line in the $LPM_n^{1/n} - \mu$ space. Market portfolio is shown by point M in the figure. A straight CML was

obtained by Bawa and Lindenberg (1979) with the help of $LPM_n^{1/n}$ instead of LPM_n framework.

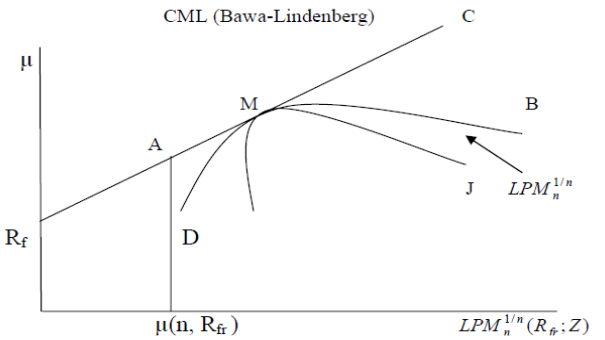

Figure 1: MLPM framework, Bawa and Lindenberg (1979)

The graphical representation of Harlow and Rao (1989) version of the D-CAPM is shown in figure 2. That has been discussed above that the Bawa and Lindenberg(1979) and traditional CAPM is the special version of this generalized framework.

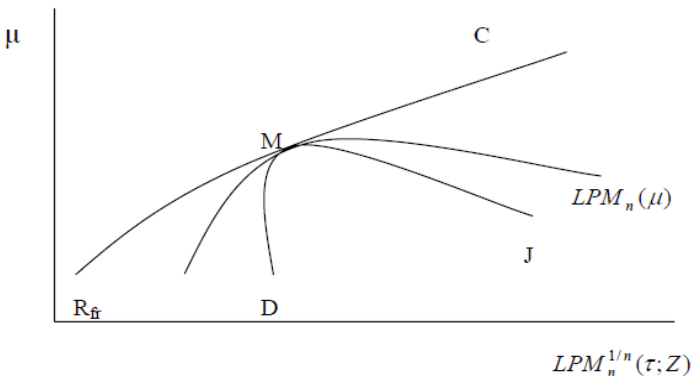

Figure 2: Generalized MLPM framework, Harlow and Rao (1989)

In the present study we used empirical version proposed by Estrada (2002) of the downside CAPM in order to test the validity of this form for four selected South Asian countries. In the model we took expected excess return on asset '*i*' as explained variable whereas market risk as explanatory variable which is being measured by $\boldsymbol{\beta_{imt-1}^{D}}$.

$$\boldsymbol{E(R_i) - R_{fr} = \propto + [E(R_m) - R_f]\beta_{imt-1}^{D}} \text{..... (1)}$$

Equation (1) considers two hypotheses in order to validate the down side risk based CAPM and they are:

H_1: $\propto$ **=0, i.e.** intercept term is zero and important.

H_2: $[E(R_m) - R_f] > 0$, Positive also significant market risk premium to bear downside risk.

Following is the diagrammatic representation of the independent and dependent variable.

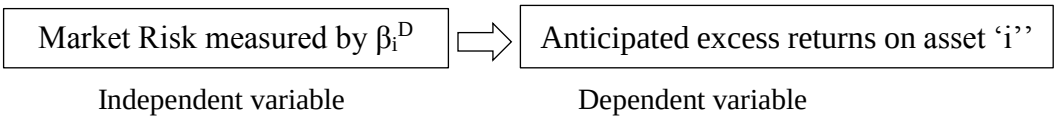

Figure 3: Theoretical Structure of the D-CAPM.

Population

Four south Asian stock markets are considered for the empirical investigation of D-ACPM e.g. Bangladesh, India, Pakistan and Sri Lanka. The details of the population in the four selected countries are explained in table 1. We have mentioned above that the selection of these four SAARC countries is been made because of the high accumulated market capitalization in the region, graph I and table II below, are evident of the fact.

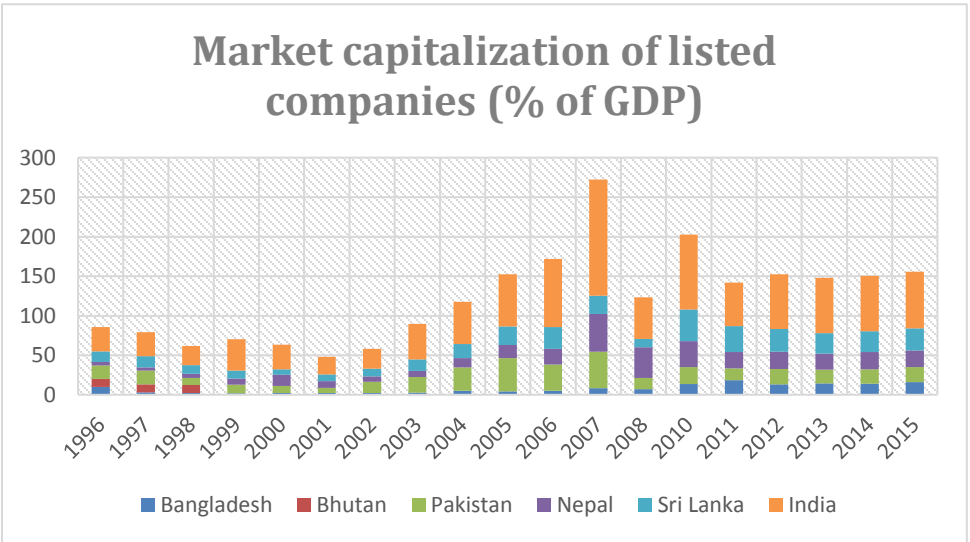

Figure 4: Market Capitalization of the Listed Companies in the Major South Asian countries

Source: Graph based on the data of World Development Indictor (WDI), 2017.

Table 1. Summary about Selected Countries Equity Markets.

Countries	Listed Companies	Market Value ($ Million)	Brokers	Stock Exchanges	Equity Turnover ($ Million)
Bangladesh	558	17,479	357	2	10,693.0
India	5,788	1,263,335	1,269	2	690,216.0
Pakistan	556	43,676	261	3	13,675.0
Sri Lanka	294	17,046	29	1	1,565.0

Source: Asian development Bank (ADB), 2016 & SAARC Finance 2017.

Sample and Data

Monthly data for the analysis started from January 2007 to December 2017. The sample selection is based on three criteria: (1) Continuous citation of companies during investigation period (2) all main segments are covered in the trial (3) organizations with high average turnover are considered for analysis. Selected stocks from each country and number of sample firms is explained in table 1. The selection of stock exchange among the others in the country is based on the size, trading volume and maturity (oldest among others).

Table 2.

Name of the stock	Sample Size
Bombay Stock Exchange (BSE), India.	440 out of 5828
Colombo Stock Exchange (CSE), Sri Lanka.	150 out of 229
Dhaka Stock Exchange (DSE), Bangladesh.	230 out of 570
Pakistan Stock Exchange (PSE), Pakistan.	320 out of 559

To proxy the market portfolio, market indices of respective stock is used. 3-months or 91 days Treasury bill (T-bill) rates are used to proxy the risk-free rate.
Monthly stock returns for empirical analysis are calculated as:

$$R_{it} = \ln\left(\frac{P_{it}}{P_{it-1}}\right) \text{..... (1)}$$

In above equation R_{it} is the return of individual stock 'i' and P_{it} is the price of the stock in the start of the month whereas P_{it-1} is the price at the end of the month so,

we have taken the ratio of the beginning and end price of a stock in a month to obtain the stock returns. Similarly, monthly market returns are calculated as:

$$R_{mt} = \ln\left(\frac{P_{mt}}{P_{mt-1}}\right) \text{ ..... (2)}$$

Again, the above equation is the ratio of the month beginning value of market index divided by end of month value.

Portfolio formation procedure

Fama-MacBeth (1973) methodology is used to check the empirical soundness of D-CAPM and to form the portfolios. Iqbal and Brooks (2007); Javed *et al* (2008, 2009) and Akbar *et al* (2012) used the same methodologies for their studies. For each stock operation, beta is calculated using rolling-window regression of 36 months, after which the portfolio is formed by sorting betas by weighing them evenly in ascending order. This procedure is repeated for each months' return for each stock and portfolio beta is calculated by taking the simple average of beta of each security in the portfolio.
Following the above procedure 44,15,23,32 portfolios were formed containing 10 securities in an each portfolio for BSE, CSE, DSE and PSE respectively.

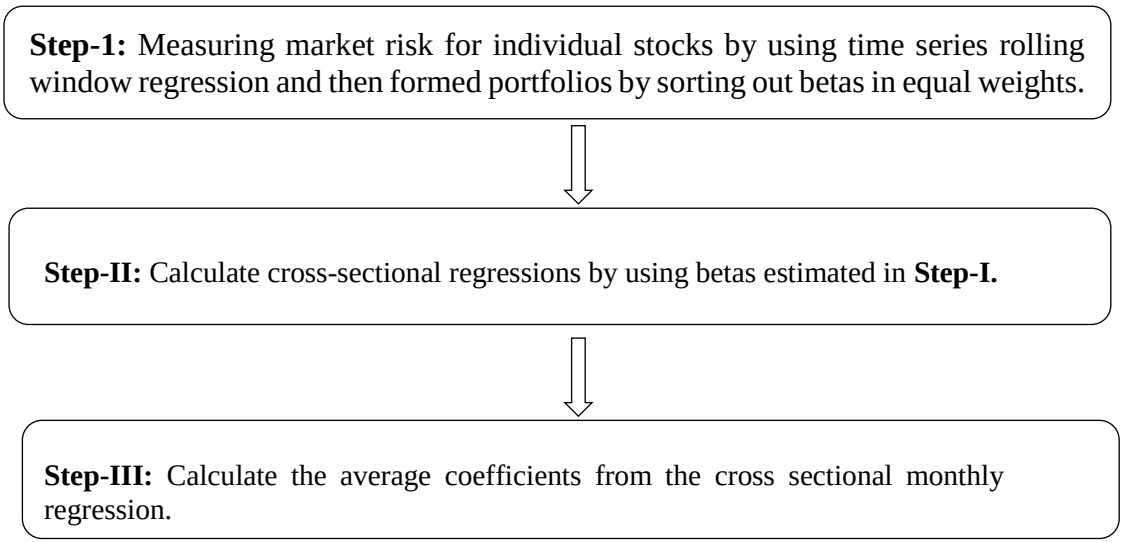

Figure 4: Fama-MacBeth Methodology

Econometric Specifications for Downside Risk Based CAPM

GMM technique is used to estimate the window period. Regression, market return and excess market returns are used as instrumental variables. The estimated model for downside risk-based CAPM is provided as follows with Estrada (2002):

$$\boldsymbol{min}[\mathbf{0}, \boldsymbol{R_{it}}] = \boldsymbol{\alpha} + \boldsymbol{\beta_{imt}^{D}}[\boldsymbol{min}(\mathbf{0}, \boldsymbol{R_{mt}})] + \boldsymbol{\epsilon_t} \text{ ..... } \textit{(3)}$$

Equation (3) is used to estimate the downward beta proposed by Estrada (2002) and to meet the problem of auto-correlation, the correct ARMA conditions are included. In the next step, portfolios were formed based on the delayed betas, and then the cross-sectional model was estimated based on the excess portfolio return of delayed portfolio payments:

$$\boldsymbol{R_{pt}} = \boldsymbol{\tau_0} + \boldsymbol{\tau_1 \beta_{pmt-1}^{D}} + \boldsymbol{\varepsilon_p} \quad \text{..... (4)}$$

Here, $\boldsymbol{\beta_{pmt-1}^{D}}$ is focused on downside risks, while $\boldsymbol{\tau_0}$ and $\boldsymbol{\tau_1}$ are the interception period and estimated risk premium.
The following hypotheses must be tested for the empirical validity of D-CAPM:

$\boldsymbol{\tau_0}$ **= 0,** the intercept term is insignificant.
$\boldsymbol{\tau_1}$ **> 0,** the market risk premium for downside risk is positive.

Empirical Results

Table 3 shows results of the downside CAPM for Bombay Stock Exchange (BSE), India. The values of the market risk premium appeared to be positive and significant at 5 percent level of significance in case of the whole sample period and as well as in case of the sub-sample periods accept 2008 to 2010 and 2011 to 2013, which is due to some political shift and instability experienced by the Indian economy. The positive risk premium is the expected outcome in our case and results are heavily supporting that hypothesis. Intercept terms are mostly also significant and different from zero.

Table 3. Average Risk Premium D-CAPM (India)

Sample Period	$\boldsymbol{R_{pt} = \tau_0 + \tau_1 \beta_{pmt-1}^{D} + \varepsilon_p}$		
	$\boldsymbol{\tau_0}$	$\boldsymbol{\tau_1}$	$\mathbf{R^2}$
2005-2007	0.03** (-1.33) [0.17]	0.01** (1.75) [1.67]	0.35

2008-2010	-0.01 (-0.39) [-0.30]	-0.02** (1.56) [0.12]	0.22
2011-2013	0.01* (2.35) [2.20]	-0.01* (-1.62) [-1.60]	0.30
2014-2016	0.01 (0.40) [0.67]	0.002** (1.61) [1.53]	0.37
2005-2017	0.004** (1.90) [1.85]	0.02** (2.90) [2.37]	0.39

*Note: Average risk premium followed by Fama-MacBeth t-values in round brackets whereas square brackets contains error adjusted Shanken t-values. *displays significant at 1 percent and ** indicates significant at 5 percent and *** illustrates 10 percent level of significance*.

Table 4 shows the results of the model for Colombo Stock Exchange (CSE), Sri Lanka. In case of CSE the market risk premium is negative for the whole trial period and for the sub trial period 2008 to 2010. Whereas the intercept term is also significant but negative for the whole sample period. By analysing some of the statistics during the period 2008 to 2010 it become clear that why model specifically has negative risk premium in sub-sample period 2008 to 2010, because during these years the whole SAARC region faced an economic downturn like GDP at constant prices showed percentage change per annum only 3.8 percent during this era, which is far below as compare to the other years (SAARC stat, 2018).

Table 4. Average Risk Premium D-CAPM (Sri Lanka)

Sample period	τ_0	τ_1	R^2
2005-2007	-0.02*** (-1.75) [-0.88]	0.04* (5.00) [3.50]	0.28
2008-2010	-0.05* (-2.64) [-2.01]	-0.02*** (-1.48) [-1.25]	0.33

2011-2013	0.03*** (1.40) [1.70]	0.002 (-0.11) [-0.11]	0.27
2014-2016	0.01* (2.37) [2.37]	0.004* (2.60) [2.00]	0.31
2005-2017	-0.01*** (-1.44) [-0.82]	-0.02** (-1.92) [-1.40]	0.43

*Note: Average risk premium followed by Fama-MacBeth t-values in round brackets whereas square brackets contains error adjusted Shanken t-values. *displays significant at 1 percent and ** indicates significant at 5 percent and *** illustrates 10 percent level of significance.*

Moving forward table 5 shows the results for Dhaka, Bangladesh. All the risk premium stated a positive magnitude, which is only in case of DSE where all risk premium appeared both positive for the whole trial period and for the trial period one reason could be the positive and healthy economic growth of the Bangladesh economy. But still we cannot conclude that these are the absolute supportive answers as values of the R^2 in most of the cases have a room of improvement and also the magnitude of risk premium which must be larger, according to the standard theory so we may say that partially the results are supportive and are better prediction than that of the standard CAPM model, we have mentioned several studies which failed to empirically validate the model in the introduction of the article.

Table 5: Average Risk Premium D-CAPM (Bangladesh)

Sample period	τ_0	τ_1	R^2
2005-2007	0.01*** (1.57) [1.54]	0.04* (3.50) [1.45]	0.41
2008-2010	0.003 (0.04) [0.04]	0.02* (2.20) [1.55]	0.35
2011-2013	0.03* (3.42) [3.30]	0.00 (-0.25) [-0.24]	0.30

2014-2016	0.01 (0.90) [0.89]	0.003** (1.80) [1.72]	0.44
2005-2017	-0.02** (-1.77) [-1.60]	0.01** (1.90) [1.77]	0.45

*Note: Average risk premium followed by Fama-MacBeth t-values in round brackets whereas square brackets contains error adjusted Shanken t-values. *displays significant at 1 percent and ** indicates significant at 5 percent and *** illustrates 10 percent level of significance.*

Lastly, table 6 illustrates the results of Pakistan Stock Exchange (PSE), Pakistan. Again by analysing the risk premium we found positive and significant results but in case of sub-sample period 2008-2010 it appeared that there is negative risk premium for this time according to our data and analysis. The results are partially supportive and somewhat inconclusive as well, but still a better result as compare to the standard model, these results are quite similar to the Galagadera and Brooks (2005) they also reported mixed and inclusive results for the downside risk based model also Akbar *et al* (2012) also concluded the same behaviour of the risk premiums. Another study conducted by Cheremushkin (2011) reported similar kind of results.

Table 6. Average risk premium of downside risk based CAPM (Pakistan)

Sample period	τ_0	τ_1	R^2
2005-2007	0.03*** (1.40) [0.75]	0.002 (-0.65) [-0.35]	0.33
2008-2010	-0.01** (-1.88) [-1.78]	-0.01*** (-1.45) [-1.20]	0.36
2011-2013	0.01* (2.39) [2.27]	0.01* (2.44) [2.14]	0.35
2014-2016	-0.05** (-1.91) [-1.41]	0.02 (0.39) [0.22]	0.41
2005-2017	0.004* (2.24) [2.19]	0.01* (2.35) [2.34]	0.47

*Note: Average risk premium followed by Fama-MacBeth t-values in round brackets whereas square brackets contains error adjusted Shanken t-values. *displays significant at 1 percent and ** indicates significant at 5 percent and *** illustrates 10 percent level of significance.*

Conclusion

The present study is an attempt of testing the empirical validity of four south Asian equity markets. These four developing and rapidly growing equity markets covers more than 75 percent of market capitalization in the region. The results are partially in favour of the downside risk based CAPM but some sub-sample periods showed results are inconclusive and insignificant intercepts also have seen, which show mispricing of securities in the respective stock exchanges. But the overall conclusion can be drawn that the downside risk based CAPM is better as compare to that of standard CAPM. The results are in line with those of Richards (1996), according to him the equilibrium asset pricing models are not quite suitable empirically for the emerging equity markets.

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