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A Comparative Risk Analysis of Bangladesh in the SAARC Region

A Study of Value at Risk

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Abstract

The aim of this study is to find out how much more risky the stock market of Bangladesh is compared to the other South Asian Association of Regional cooperation (SAARC)[1] countries and investigate the role of it in this region from risk perspective. Bangladesh is one of the potential markets for investment among the eight countries of SAARC. It is therefore high time to study market risk associated with the countries stock market. Value at Risk (VaR) has been applied to estimate market risk of the four countries. To evaluate competitive advantage of Bangladesh from risk perspective a portfolio analysis was conducted with three other SAARC countries. Two portfolios were created with and without Bangladesh to see whether it increases or decreases portfolio risk. Incremental Value at Risk (IVaR) was used to estimate the additional risk produced by including Bangladesh into the portfolio. Components Value at Risk (CVaR) was applied to measure individual countries contribution to the portfolio risk. Bangladesh was found less risky compared to India and Pakistan and inclusion of Bangladesh to the portfolio reduced the risk.

Key Words: Value at Risk (VaR), Incremental Value at Risk (IVaR), Components Value at Risk (CVaR), Bangladesh, DSE, SAARC

[1] South Asian Association of Regional Cooperation (SAARC) is an organization established in 1985 with an aim to ensure peace and prosperity through economic cooperation within the region

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1. Introduction

Recently, there has been a growing interest regarding investment in the South Asian region. Over the years the countries have made remarkable development to their economies. For the promising economic and financial performance foreign investors are very interested in this part of Asia. The region also framed eight countries of South Asia with an economic block known as South Asian Association of Regional Cooperation (SAARC). This economic zone contains Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka and recently added Afghanistan. Among these countries Bangladesh, India, Pakistan and Sri Lanka have outstanding achievements regarding economic growth. As Bangladesh is in the center of this study it is very important from the potential investors perspective to find out the risk associated the with countries stock market.

Bangladesh has always been in focus of the Asia as well as the western world. The geographical location of it has turned out to be the key interest. Over the recent decades within short span of time Bangladesh achieved remarkable economic development. Despite being a small country with very limited natural resources compared to India and Pakistan, Bangladesh has been competing very well in the region. According to Goldman Sachs Bangladesh is one of the eleven emerging economies. Very recently it has been added to the Goldman Sachs N-11equity portfolio. Impressively, over the next decades, the N-11 economies are estimated to grow by 2050 and they could account for 17% of global (GDP Goldman Sachs Asset Management). Ahmed (2013) in The Financial Express explains, single digit inflation played an important role on including Bangladesh to N-11. World's Major automobile, it and tech, pharmaceuticals, garments etc. industries are keenly interested to establish their manufacturing unit in Bangladesh.

A large young, talented, dynamic as well as ambitious workforce with favorable opportunities is the main attractions for potential foreign investment. The main idea behind the study is to unveil the riskiness of investment in Bangladesh.

From SAARC countries only Indian stock market belongs to emerging market and other three countries stock market belongs to frontier market. Only Pakistan has three capital markets whereas Bangladesh and India have two stock markets each and Sri Lanka has only one stock market. The major capital markets of Bangladesh, India, Pakistan and Sri Lanka are Dhaka Stock Exchange (DSE), National Stock Exchange (NSE), Karachi Stock Exchange (KSE) and Colombo Stock Exchange (CSE). In 2012 market capitalization of DSE, NSE, KSE and CSE were respectively $ 17.479 billion, $ 1.263 trillion, $ 43.676 billion and $ 17.046 billion. In 2015 the market capitalization of Bangladesh reached to $ 39.71 billion. The stock markets of India and Bangladesh already have gone through demutualization and others are in the process. Most of the markets are going through massive development phase. According to Metzger (2010) "Indeed, South Asian equity markets are rallying strongly; since 2001 market capitalization has steadily increased by at least 140 per cent in Bangladesh".

Some of the stock markets of this region are extremely volatile. Most of them are heavily dependent on equity which makes the markets more volatile. The Dhaka Stock Exchange (DSE) major capital market of Bangladesh experienced two major crashes in 1996 and 20011. Sarker (2012) says the stock market crash in 1996 took place due to speculative bubble and asset bubble was the reason behind 2011 crash. But since then authorities have taken steps to improve the market. It's a logical question that how risky the market will be over the coming years. In this study we will find out risk associated with the stock market compared to the neighboring

countries. It is therefore high time to figure out how much risky it is to investment in Bangladesh compared to the neighbors.

Over last couple of decades Value at Risk (VaR) has been a standard form of risk measurement. Duffie and pan (1997) claim that Value at Risk is a standard benchmark for risk measurement. The history suggests that concept of VaR was used from the beginning of 19th century in different forms but it took a long time until nineties to get a standardize form. J.P. Morgan used their version of risk metrics to estimate risk for next day which is known as the famous 4:15 report. Then it proved to be a very useful tool for risk estimation and everyone started using it. According to J.P. Morgan (1997), VaR tells how much one can lose with certain probability over pre-set time horizon. According to Benninga (1998) "Value-at-Risk (VaR) measures the worst expected loss under normal market conditions over a specific time interval at a given confidence level". VaR is generally estimated for specific period which termed as holding period and it can be daily, weekly, monthly or yearly. For example an investment on General Motors stock of $ 1,000,000 has an on day VaR of 7% with 95% confidence interval. It means that there are 95% chances that it will not lose more than 7% the next day. It is reliable and useful compared to the other risk models.

In1996 the Basel Committee issued the Market Risk Amendment[2] where banks were allowed to use Value at Risk model. VaR was mandatory requirement for Basel 2 and still is for the upgraded Basel 3 requirements. Chen (2014) said the Basel Committee in the recent accords known as Basel 2, 2.5 and 3 has embraced Value-at-risk (VaR), Stressed VaR and Expected

[2] Basel Committee on Banking Supervision: History of the Basel Committee. Available at: http://www.bis.org/bcbs/history.htm

Shortfall as fundamental measure of market risk in global banking regulation. Not only the banking sector but also the financial sectors especially in developed financial markets use VaR models as standard for market risk measurement.

To find out the riskiness of the stock market of Bangladesh I used the parametric VaR model. For the India, Pakistan and Sri Lanka same model was used. A five year data sample was taken from January 2010 to 2014 to estimate VaR for the year 2014. At first parametric approach Student t-distribution with three different variances were used to see which fits the data best. The Kupeic test showed Exponentially Weighted Moving Average (EWMA) variance passed test. To compare the market risk of Bangladesh with three other countries VaR was estimated only with EWMA variance. Then a portfolio analysis of VaR was conducted to see the impact of Bangladesh to the portfolio risk. Two portfolios were created, one included Bangladesh and the other one contained only India, Pakistan and Sri Lanka. IVaR was applied to see how much risk was added or reduced by including Bangladesh into the portfolio. CVaR was applied to decompose the portfolio risk into individual countries. The findings showed Bangladesh was less risky than India and Pakistan and it played a vital role by reducing portfolio risk.

This kind of study involving comparative and portfolio risk analysis of SAARC stock markets using VaR, IVaR and CVaR is very rare. The findings of this study are very significant for the concerned authorities of Bangladesh, the potential investors as well as South Asian countries. This work will give new dimension to the study of stock market risk of Bangladesh and the SAARC region.

Here is a small outline of the whole thesis. The introduction part is followed by the background section where backgrounds of SAARC, Bangladesh and stock exchange are given. One of the

most important chapters is the previous study where few earlier studies about the stock market volatility of SAARC countries have been discussed briefly. Concepts of VaR is the next chapter and it contains definition of VaR, IVaR, CVaR and Kupeic test. Then comes Methodology and Data chapter, this chapter explains about different methods that were used to estimate VaR for individual country VaR estimation and portfolio VaR estimation. This chapter then describes how the sample data were collected, descriptive statistics and indices of four countries. It also contains estimation sub section which explains how the VaR methods were implanted especially the motivation and the strategy behind the portfolio creation. The results and analysis chapter into four sub section, first it presents VaR estimates with different variances then comparison of VaR of four countries followed by Kupiec test results. The fourth section of this chapter presents the important portfolio analysis of four countries with IVaR and CVaR. The conclusion part summarizes the whole thesis with final findings. It is then followed by reference chapter where all the references of the journals, papers, articles and books used in this study. This study ends with the appendix chapter.

2. Backgrounds

SAARC

The idea of creating South Asian Association of Regional Cooperation (SAARC)[3] was initiated and proposed by Bangladesh during the period 1977-1981. In 1981 the proposal was accepted by seven countries including Bangladesh, India, Pakistan, Sri Lanka, Nepal, Maldives and Bhutan. The South Asian Association for Regional Cooperation, established in 1985, was the first regional cooperation in South Asia to promote active collaboration and mutual assistance in economics, social, cultural, technical, and scientific fields; to strengthen cooperation among the member states in international forums on matters of common interest, Jullien Grollier (2009).

Bangladesh

Bangladesh is country from the South Eastern part of Asia. Bangladesh became independent and sovereign country in 16th December, 1971. It has shared borders with Myanmar and India. The population of Bangladesh[4] is 150 million, GDP of $ 150 billion and GNI per capita is $ 1010 as of 2013. The current point to point basis inflation rate as of February 2015 from Bangladesh Bank is 6.14%. Bangladesh Bank is the Reserve Bank and the fiscal year is from June to July. The country is going through transitional phase of moving from agriculture to industrialization. It has been a major exporting country of readymade garments, medicine, leather goods, electronics,

[3] Information and data of SAARC were taken from SAARC Statistical Year Book (2012), available at: saarc-sec.org/ areaofcooperation/detail.php?activity_id=4

[4] GDP, GNI and population information were collected from World Bank and available at: http://data.worldbank.org/country/bangladesh

jute products, vegetables etc. Bangladesh is the world's third largest exporter of readymade garments. The emerging industries of the country are pharmaceuticals, IT and software, electronics and automobile. There are two major financial markets, the Dhaka Stock Exchange (DSE) and Chittagong Stock Exchange (CSE).

Dhaka Stock Exchange (DSE)

Dhaka Stock Exchange Ltd. (DSE)[5] operates as a major stock exchange in Bangladesh. The company offers various investment products for investors, such as ordinary shares of listed companies, mutual funds, debentures, and bonds. The company was founded in 1954 and is based in Dhaka, Bangladesh. Total 311 issues trades in DSE everyday with current market capitalization as of 4/13/15 $ 40.06 billion at an exchange rate of 77.47 taka per dollar. There are three main indices DSEX, DSE 30 and DSES which were designed and developed by S&P Dow Jones Indices. NASDAQ OMX and Flex Trade Systems are upgrading DSE trading system.

[5] All the information about DSE were collected from Bloomberg website- http://investing.businessweek.com/Research/stocks/private/snapshot.asp?privcapid=32985526 and DSE website- http://www.dsebd.org/

3. Previous Studies

This chapter contains previous studies study relating volatility on stock markets of the SAARC countries. Although there has been a limited number of studies but still it is valuable. Value at Risk was rarely used to study the volatility of capital markets of this region. From this situation it is very difficult to portray exact scenario of the volatility in this region based on previous studies. In this section few previous studies are presented to get a brief idea of volatility in stock markets of SAARC region.

Some studies have been conducted focusing on the stock market of Bangladesh. Hasan, Islam and Bashar (2000) examined the market efficiency, time varying volatility and equity returns in capital market of Bangladesh. They used a unique data set and found significant relationship between conditional volatility and the stock returns but the risk and return parameters were negative and statistically significant which is inconsistent with portfolio theory. The circuit[6] breaker was completely ineffective on stock volatility. The stock market of Bangladesh was found inefficient.

Metzger (2010) studied the trends in financial market development of the SAARC countries and found that there has been an incredible development of financial market both across country and across divers segments especially by Bangladesh, India, Pakistan and Sri Lanka. Banking sector is the major sub section of the financial market for these countries. After 2001 the market

[6] Circuit Breaker is the maximum permissible deviation of the price (specified as percentage) of the incoming order from the Circuit Breaker (Dhaka Stock Exchange)

capitalization has increased gradually especially 400% for Pakistan and 140% for Bangladesh. Strong stock price is accompanied by reasonable level of volatility. Even small portfolio flows can lead to high asset price volatility due to small market capitalization and market turn-over.

Torres, Wells and Khan (2013) examined the development and barriers to harmonization integration of among the stock market of the SAARC countries. They said that integration has greater benefits of competition, innovation, deeper liquidity and attracting wider participant. Few countries including have demutualized the stock exchanges and most of them are in the process. Shortage of information and lack awareness of the benefits of the integration are the barriers other than exchange control. The markets present much instability, where few of them gone through extreme volatility and most of them are in torment of volatility crisis. Most of the markets surprisingly, experiencing common problems of low volumes, excessive volatility, and difficulties in enforcement.

Hossain (2013) conducted a study to find out whether there was any correlation between capital market index of Bangladesh and real GDP growth rate of the world. The results showed that there was no significant correlation between the two variables inferring that the great recession of 2007-2009 did not significantly affect the capital market of Bangladesh. He also found that the capital market of Bangladesh does not share a common trend with USA capital market. He explained the domestic factors that might have played role in the findings are low market capitalization, market inefficiency, strict monitoring and control by the Security and Exchange Commission and low international participation in the stock market of Bangladesh.

Islam and Jahan (2012) conducted a study on the capital market of Bangladesh to evaluate the existing financial instruments and recommend policies for implementing new instruments. There

are five instruments trading in Dhaka Stock Exchange including three types of bond and it heavily relies on common stock which accounts for 87.73%. There is lots of opportunity for absorbing new products especially the corporate bond has lot of scopes. The introduction of new instruments will reduce risk of dependency on common stock. They also recommended new financial instruments like financial instruments are various types of bond, SWAP, Option, Futures.

Rahman and Moazzem (2011) investigated the volatility in Dhaka Stock Exchange and role of regulators of. They used Vector Auto Regressive model to test the volatility. The relationship found between the decision taken by the regulatory authority and market volatility was found statistically significant. Analysis shows that the market became more volatile over time. Remittance inflow and commercial deposit rate macro variables had negative and unidirectional influence on volatility which was mentioned by Döpke et al. (2005).

Hasan, Alam, Amin and Rahman (2014) investigated the existence of size and value premium effect in Dhaka Stock Exchange from 2004 to 2013. The evidence showed that small firms with high book to market had higher return than large firms with low book to market ratio. They also examined the might of three factor Fama and French model to show the variation in stock return and found that the small size with high book to market firms had higher volatility returns than large size firms with low book to market ratio.

Ahsan, Gani and Hasan (2014) examined the impact of changing margin requirement on stock return volatility in Dhaka stock Exchange. They found that the relation between the margin requirement change and margin requirement were not statistically significant.

4. Concepts of VaR

Here the concepts of the VaR methods are given shortly. All the concepts are taken from the book written by Kevin Dowd. For more information see Dowd (2002).

4.1 Value At Risk

The mathematical definition tells that Value at Risk is the bearable or smallest loss "l" and the probability of having the unbearable or worst loss "L" larger than "l" is 1-α. The following formula defines VaR,

$$VaR_{\alpha}(L) = \min\{\ell : \Pr(L > \ell) \leq 1 - \alpha\} \quad \textbf{[1]}$$

Value at Risk is not the risk estimated for today it is estimation of the future loss. It tells us how much we can lose in the future. For the VaR calculation loss distribution is taken into consideration which means loss is positive in this case. The holding periods defined by h and confidence interval by α are the important parameters of VaR estimation. The holding period defines for how many days VaR will be estimated and it can be daily, weekly, monthly or yearly. Popular confidence intervals used are 90%, 95% and 99%. VaR can be express both in percentage or the amount of loss. For continuous loss distribution below formula is appropriate,

$$\Pr(L > VaR_{\alpha}(L)) = 1 - \alpha \quad \textbf{[2]}$$

Parametric Approach

The parametric approaches are estimated based on different probability distribution. Popular parametric approaches are Normal Distribution, Student t-distribution (t-dist.) and Lognormal distribution. These approaches rely on the distributional assumptions.

VaR estimation under normal distribution is simple and easy. But it is not suitable for all instruments especially financial instruments as it can not capture the excess kurtosis. The following formula is applicable for VaR estimation under normal distribution where μ is the mean, σ_{T+1} is one day ahead volatility and z_α is the α-quantile for this distribution.

$$VaR_\alpha(L) = \mu + \sigma_{T+1} z_\alpha \quad \textbf{[3]}$$

Among them t-dist. is appropriate for the financial returns as it has excess kurtosis[7]. Student t-distribution is almost similar to the normal distribution except for the kurtosis. The kurtosis of normal distribution is 3 and t-dist. has larger than 3 so it can accommodate financial returns with fat tails. To estimate VaR under t-dist. three parameters volatility (σ), mean (μ) and degree of freedom (v) are required. Volatility can be estimated by standard deviation. There is a problem with this approach is that the underlying assumption says volatility is constant so it does not consider volatility clustering. This problem can be overcome by alternative time varying models Exponentially Weighted Moving Average (EWMA) and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) which are forward looking and considers volatility clustering.

[7] Kurtosis explains the long and fat tails of a distribution

$$\sigma_t^2 = (1-\lambda)e_{t-1}^2 + \lambda\sigma_{t-1}^2 \quad [4]$$

$$\sigma_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \quad [5]$$

Here omega (ω) is the intercept term, lambda (λ) is constant at 0.94, alpha (α) and beta (β) are coefficients, residual (ε) is the error term and sigma square (σ^2) is the variance.

The third parameter degree of freedom controls the kurtosis. For $v > 4$ is used to explain the relation between sample kurtosis *k* and degree of freedom *v*:

$$k = \frac{3(\nu-2)}{\nu-4} \Leftrightarrow \nu = \frac{4k-6}{k-3} \quad [6]$$

The t-dist. can not be initiated if the sample kurtosis k<3 because it suggests the tails are very thinner even than normal distribution. In that case even normal distribution cannot be used and this is a very unusual case. Once we have all the three parameters in hand the VaR under t-dist. can be estimated by the following formula:

$$VaR_\alpha(L) = \mu + \sqrt{\frac{\nu-2}{\nu}}\sigma_{T+1}t_{\alpha,\nu} \quad [7]$$

Here μ is the mean, v is the degree of freedom, σ_{T+1} is next day's volatility and $t_{\alpha,v}$ is the α-quantile for this distribution.

4.1.1 Advantages & Disadvantagess of VaR

VaR is very attractive and popular tool for the risk estimation tool recently. It has been as standard for risk measurement since late nineties by financial institutions. The main attraction of the model is simplicity. According to Linsmeier and Pearson (1996), "Subject to the simplifying

assumptions used in its calculation, value at risk aggregates all of the risks in a portfolio into a single number suitable for use in the boardroom, reporting to regulators, or disclosure in an annual report". The implementation of the model is not that difficult. Most importantly it is capable answering the most evitable question "How much the asset or instrument will lose in future?" It is the biggest concern for the authorities especially the investors. Compared to the other risk model it is accurate and result is easily understandable. It can be applied to any instruments such as stocks, bonds, derivatives etc. Like every other models it also has some drawbacks. The biggest problem with VaR model is it does not tell more information about after VaR estimation. It says nothing specifically about how much an asset can lose more than VaR. One of the major problems is that it does not work accordingly during a financial crisis. Jorion (1996) says, "Any VAR number is itself measured with some error, or estimation risk".

4.2 IVaR & CVaR

Incremental Value at Risk (IVaR) is the portfolio risk management theory which tells us the impact on the risk by the additional changes. It is a measure how much a portfolio risk increases or decreases by adding a new position to the portfolio. IVaR indicates reaction of the portfolio risk by new change in portfolio position. To estimate IVaR two portfolios is required first one with existing assets and the second one with new asset. Subtracting portfolio 1 from 2 we get the IVaR. For example we have portfolio V containing three assets and adding a new asset to it a new portfolio (V+a) is created. Then we estimate VaR for each portfolio and subtract V from (V+a) gives IVaR.

$$\mathbf{IVaR}_{\alpha}\mathbf{(a) = VaR}_{\alpha}\mathbf{(V+a) – VaR}_{\alpha}\mathbf{(V)} \qquad \textbf{[8]}$$

Here (V) is the first portfolio and (V+a) is portfolio with added asset. An IVaR can be positive or negative. A very high positive result indicates that it has increased the portfolio risk highly. A negative result means it's a natural hedge to the portfolio. It highly reduces portfolio risk and it will lower the risk if added more but only to a relevant range and then it will rise.

CVaR tells how much each asset contributes to the portfolio risk. It separates the assets into components which explain risk associated with each asset. It helps to identify the risky assets as well as assets that reduce risk. To estimate CVaR we need a portfolio for which the risk can be decomposed. For example we can take the portfolio (V+a) to decompose. Beta and weight for each asset is required.

$$\mathbf{CVaR = w\,\beta\,VaR\,(p)} \qquad \textbf{[9]}$$

We have to calculate CVaR for each of the asset in the portfolio. In the end all the CVaR will sum equal to the portfolio risk. It provides valuable information about the riskiness of every single asset. The results of CVaR can be similarly interpreted as IVaR, positive results indicate risky and negative means hedge.

4.3 Kupiec Test

The most reliable and standard test for backtesting VaR estimates is Kupiec frequency test or in general Kupiec test. It validates the VaR estimates by comparing actual with expected losses. When the loss observation is larger than the VaR estimate then it is called VaR violation. When the loss is larger than the estimate it is denoted by 1 and 0 when it is smaller. Kupiec test gives range for the violation. For given VaR model in a specific test period loss is compared with the VaR estimate to get the sum of the violation. If the actual violations exceeds the Kupiec ranges

in both high and low ranges then the model is rejected. The Kupiec test is a binomial test because the Burnoulli variable only accepts ones and zeros and the total of the Burnoulli distributed stochastic variables is binomially distributed variable. The VaR violations in sample can be found by formula no. 8, where the N is the test period and p=1-p is the expected frequency of VaR violations.

$$\Pr(X = x) = \binom{N}{x} p^{x}(1-p)^{N-x} \qquad \textbf{[10]}$$

5. Methodology & Data

In this section we will talk about methods applied to estimate VaR, IVaR and CVaR. This section also explains the data collection, indices of four countries and descriptive statistics of the data sample. At the end of this chapter there is an estimation section where the implantation of the VaR methods is explained briefly.

5.1 Methodology

To achieve the goal of this paper Value at Risk was applied to the data sample from 2010 to 2014. For the risk analysis parametric approach Student t-distribution was used with confidence interval of 95% to estimate VaR. It was calculated for all four countries Bangladesh, India, Pakistan and Sri Lanka. Only for Bangladesh t-dist. was estimated with three different variances and they are normal Standard deviation, EWMA and GARCH (1.1). The reason behind using three different variances was to see which model fits data well. Except the normal standard deviation the other two methods is forward looking and takes volatility clustering[8] into account. For comparative analysis of four countries only EWMA variance was applied to estimate VaR. To discover the role of Bangladesh in the SAARC region from risk perspective a portfolio analysis was conducted using Incremental VaR (IVaR) and Components VaR (CVaR) for portfolio risk estimation. IVaR was estimated under normal distribution with 95% confidence interval. The estimation shows performance of SAARC countries with and without Bangladesh.

[8] Volatility clustering is the observation, according to Mandelbrot (1963), "large changes tend to be followed by large changes, of either sign, and small changes tend to be followed by small changes."

The CVaR breaks down the portfolio risk into each countries risk contribution. So it used the portfolio risk that contains Bangladesh.

The VaR models have gone through the backtesting process. The Kupiec test was conducted to test whether the models were valid or not. It is one of the standard and reliable tests to check VaR models. Study like this using VaR and a comparative analysis with SAARC region stock markets will be among the very few studies. This study will help the academicians, potential and existing investors as well as the regulators. The use of VaR is yet to be popular in the region but this analysis will encourage using the model as it gives a complete different. It is lot advanced and forward looking than the tradition risk models. The major limitation is it will not create any new model or theories. Study of such kind uses the existing theories and models. Within such a short period of time it is almost impossible to create a new theory where it might take years to establish one theory. Also there are lacking of more advanced skills and techniques. One of the biggest limitations of the work was the unavailability of data for few stock markets. Data for few countries were found only for few years so it not possible to conduct the study on a longer time horizon. It may also have impact on the results.

5.2 Data

The data of four countries were taken from the Thomson Reuters DataStream[9]. The data has daily closing price from 1st January, 2010 to 30th December, 2014. Total five years of data has been collected for the VaR estimation. Although it's a short period of data enough to conduct thesis like this. Total 1302 loss observation is available including the 260 observation of test

[9] https://forms.thomsonreuters.com/datastream/

period. 2014 is the chosen as the test period to ensure the maximum use of the data. Besides the annual VaR estimation 65 days of quarterly estimation will also be calculated. The periodic return is selected to calculate one day index return. Periodic return equals R_t - R_{t-1}/ R_{t-1} here R_t is the current days return and R_{t-1} is the previous days return. But for VaR estimation we need loss observation rather than return so simple multiply by -1 with the returns to get the loss observation. All the data is set to calculate one day VaR for four countries.

5.2.1 The Indices

For all type of VaR estimation a total of four indexes were used. All of them are index of four SAARC countries. The data was taken from Data Stream. The indices are MSCI Bangladesh, MSCI India, MSCI Pakistan an MSCI Sri Lanka. According to MSCI all three countries belongs to the frontier market and only India belongs to the emerging market. The MSCI indexes both for frontier and emerging markets measures the performance of the large and medium cap segments of the markets. The indexes cover around 85% of the equity universe with 65, 15 and 3 constituents respectively from India, Pakistan and Sri Lanka. All the indexes are calculated based on the MSCI Global Investable Indexes (GIMI) Methodology.

5.2.2 Descriptive Statistics

The table 3.1 presents the descriptive statistics for return distribution of four country indexes. The key statistics we will focus is excess kurtosis. Here excess kurtosis is in excess of normal distribution and we know that kurtosis of normal distribution equals 3. Bangladesh has the highest excess kurtosis of 18.03003 and then Sri Lanka with 5.31925 and the rest has lowest excess kurtosis compared to these two countries. The excess kurtosis indicates the distribution

has fat tails and empirical studies suggest that financial data has fat tails. From the table it is evident that normal distribution cannot capture this kurtosis. Student t-distribution is suitable for this data set as it is especially designed to capture excess kurtosis. We can see all the countries showing negative Skewness except Sri Lanka which shows positive Skewness. This statistics is for the return distribution so left tail presents loss. The negative Skewness tells left tails are fat (vice versa). Bangladesh has the highest Skewness of -0.24117 and Sri Lanka has 0.37359. Pakistan has the highest mean of 0.0058 and then Sri Lanka, India and Bangladesh respectively. The standard deviation says Bangladesh leading with 0.01776 which is high compared to all four countries.

Table 3.1: The table shows descriptive statistics for countries from 2010 to 2014

Statistics	*Bangladesh*	*India*	*Pakistan*	*Sri Lanka*
Mean	0.00028	0.00033	0.00058	0.00051
Standard Deviation	0.01776	0.01034	0.01018	0.00976
Excess Kurtosis	18.03003	1.01861	1.97552	5.31925
Skewness	-0.24117	-0.01495	-0.08015	0.37359
Minimum	-0.15244	-0.04104	-0.04446	-0.06903
Maximum	0.16635	0.03809	0.03858	0.06505
Number of Return Observation	1303	1303	1303	1303

5.3 Estimation

This section will explain the implementation of the VaR methods. Student T-distribution was selected for VaR estimation of four countries. Normal distribution was used estimate IVaR and CVaR. All the estimation was calculated using Microsoft Excel.

5.3.1 VaR Estimations

To estimate VaR under Student T-distribution three parameters mean μ, standard deviation σ, alpha α and degree of freedom *v* were required. Five years one day data from 2010 to 2014 of four countries were available. First periodic return was calculated for 1303 observation for Bangladesh then they were converted to loss by multiplying -1 with the return. Here three different standard deviations were used to calculate VaR. All the parameters were calculated in excel. Then a rolling window of 1043 observations rolled over to estimate one day VaR for the period of 2014. The same procedure was followed for India, Pakistan and Sri Lanka but only with EWMA variance.

5.3.2 IVaR & CVaR Estimations

To calculate IVaR and CVaR two portfolios of countries were required one with Bangladesh and the other without Bangladesh. First portfolio named (V) was created taking India, Pakistan and Sri Lanka. The other portfolio was created just including Bangladesh in portfolio (V) which was named (V+a). Portfolios were calculated applying simple portfolio theory. The strategy was to invest on the country that had less variance with higher mean (see Table A.2, appendix) return. The weights[10] (see Table A.1, appendix) were assigned based on the investment amount on each country. The total investment on this portfolio (V) was $1,000,000. So I invested $ 500,000 in Sri Lanka as it had lowest VaR as well as highest mean return and $ 200,000 on Pakistan as it most risk with high mean return of 0.0006, $ 200,000 were invested in India. Portfolio (V+a) was created with total investment of $ 1,100,000, everything is same as the portfolio V except

[10] Weight of a country in portfolio was calculated, Individual Investment/Total Investment

the inclusion of additional investment of $ 100,000 on Bangladesh. In the end it became perfect diversified portfolio (V+a) by adding Bangladesh as it was negatively correlated with India and Sri Lanka. The IVaR was estimated using normal distribution with 95% confidence interval. For the IVaR calculation mean, standard deviation and z_α were calculated for two portfolios. Applying the formula IVaR was calculated. For the CVaR calculation required weight of individual country and beta were calculated in excel and applying the formula CVaR for four countries were estimated. In both IVaR and CVaR return observation was used instead of loss observation.

6. Empirical Results & Analysis

This chapter presents the result analysis of the VaR estimates for Bangladesh, India, Pakistan and Sri Lanka. The chapter is divided into four different parts. The first part presents VaR results of Bangladesh with three variances then second part presents VaR results of Bangladesh, India, Pakistan and Sri Lanka with only EWMA variance. The first two parts are followed by Kupiec test and the final part presents results and analysis of IVaR and CVaR. For the better understanding the test period is presented both quarterly as well as annually. The test period is 2014 consisting 260 loss observation. The total observation is divided into four quarters, each containing 65 loss observations.

6.1 VaR Results & Analysis of Bangladesh

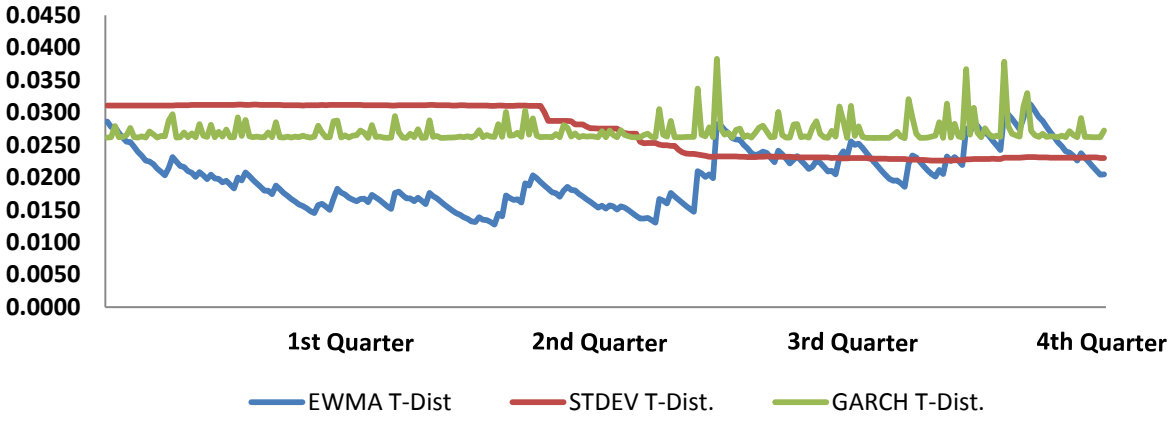
Three different types of standard deviation were only used for Bangladesh for VaR estimation. One day VaR was estimated under student t-distribution and all the estimates followed a confidence interval of 95%. Table 1 is presenting average of annual and quarterly one day VaR estimation of Bangladesh. Three different volatilities EWMA, Standard deviation and GARCH were used to estimate VaR. In the first quarter VaR estimation with EWMA volatility showed lowest average VaR compared to the two other volatilities. It remained low for the following two quarters but it was highest in the last quarter. The average quarterly VaR estimation with standard deviation volatility showed it had the highest VaR except the fourth quarter. VaR estimation with GARCH volatility remained second highest and highest in the last quarter. The average annual VaR estimation with EWMA, Standard Deviation and GARCH were 0.0202, 0.0271 and 0.0270 respectively.

Table 1: Average VaR estimation for Bangladesh with three standard deviations

Quarter	EWMA	STANDARD DEVIATION	GARCH
Quarter 1	0.0200	0.0311	0.0268
Quarter 2	0.0164	0.0305	0.0267
Quarter 3	0.0202	0.0241	0.0272
Quarter 4	0.0243	0.0229	0.0273
2014	0.0202	0.0271	0.0270

The main idea behind using three different variances was to estimate VaR to see which one best fits the data and gives better estimation. It was conducted to choose best variance for VaR estimation of four countries. Below figure 1 shows VaR estimate with EWMA variance was different from two other estimates. The VaR estimate with normal variance presented a straight line. The VaR estimate with GARCH (1.1) variance presented

Figure 1: Quarterly VaR estimate with EWMA, STANDARD DEVIATION and GARCH



Among the four periods the last period showed frequent movements in the volatility. In all the four quarters EWMA did not follow a specific trend it was diversified with all sorts of movements which makes it an ideal estimate of volatility according to the Kupiec test. It fits best

with volatility of the stock market of Bangladesh which will be discussed in the Kupeic test section. The GARCH (1.1) is also an advanced estimator but it did not quite fit with this small data sample rather it might have worked better with large data sample. The standard deviation stayed very flat throughout the period. So I choose EWMA variance for VaR estimation to compare four countries market risk.

6.2 VaR Results & Analysis of Four Countries

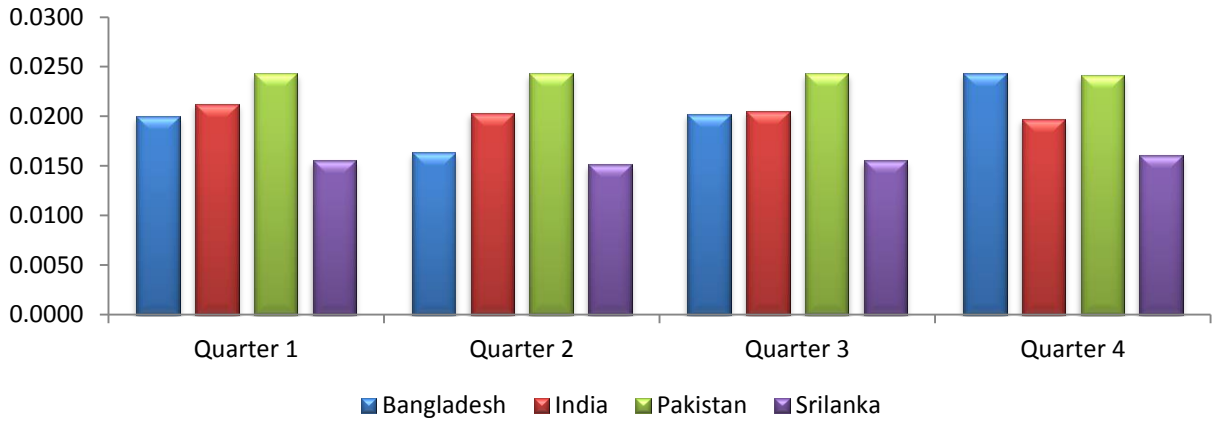
To compare four (Bangladesh, India, Pakistan and Sri Lanka) countries market risk, VaR was estimated with only EWMA variance. The table below shows average VaR results of four quarters for these countries. Pakistan had the highest average VaR of 0.0243 throughout the four quarters. India with an annual average of 0.0205 stayed close to Pakistan. On the other hand Bangladesh had second lowest VaR (0.0202) in first four quarters but had highest VaR in the fourth quarter with 0.0243 among four countries. Sri Lanka had the lowest VaR throughout the four quarters. From table 2 we can see the average annual VaR estimates for Bangladesh, India, Pakistan and Sri Lanka are respectively 0.0202, 0.0205, 0.0243 and 0.0156. Pakistan has the highest volatility and India has second highest. On the other hand Bangladesh is second lowest and Sri Lanka is the lowest volatile country.

Table 2: Average annual and Quarterly VaR of four countries

Quarters	Bangladesh	India	Pakistan	Sri Lanka
Quarter 1	0.0200	0.0213	0.0243	0.0155
Quarter 2	0.0164	0.0203	0.0243	0.0152
Quarter 3	0.0202	0.0205	0.0243	0.0155
Quarter 4	0.0243	0.0197	0.0242	0.0161
2014	0.0202	0.0205	0.0243	0.0156

We can see both from the table 2 and figure 2 that Bangladesh had the second lowest VaR estimate where as has the second highest and Pakistan has the highest VaR estimate for the first period. Sri Lanka leading the quarter with lowest average VaR estimates. In the second quarter Bangladesh is still the second lowest volatility holder with much lesser volatility than Pakistan and India. Pakistan remain the highest volatility holder and India second highest. The volatility of Sri Lanka remains unchanged. In the third quarter Pakistan and Sri Lanka became highest and lowest average VaR holder. Bangladesh and India were almost same in that quarter. Fourth quarter shows different picture where Bangladesh has the highest risk and Pakistan has the second highest risk. Sri Lanka as usual holds the lowest position and India second lowest.

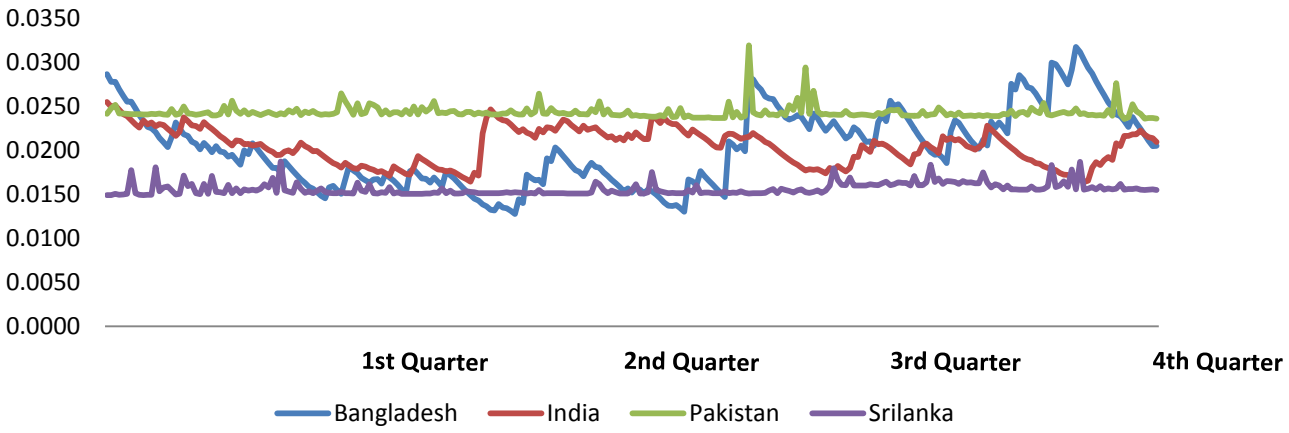
Figure 2: Average quarterly VaR estimates for Bangladesh, India, Pakistan and Sri Lanka



From the quarterly average VaR estimates for 2014 it is evident that three out of four quarters Bangladesh had been the country with second lowest volatility. Even the annual average VaR estimates suggest that Bangladesh is the second lowest volatile country. Bangladesh is third in ranking from the top and second from the bottom. So we can say that the stock Market of Bangladesh (Dhaka Stock Exchange) is less risky than India and Pakistan as well as among other SAARC countries except Sri Lanka.

VaR was estimated with only EWMA variance for Bangladesh, India, Pakistan and Sri Lanka for the period 2014. From figure 3 we can have a clear view of the scenario. In the first quarter Pakistan has the highest VaR estimate. It remained flat with barely any movement throughout the quarter. Sri Lanka has the lowest VaR estimate for the period. Like Pakistan it also presented a flat line but with very little movements. Bangladesh started with period high volatility but maintained a downward trend all the time. Whereas India starting below Bangladesh but remained above the whole time.

Figure 3: Quarterly comparison of VaR estimates among Bangladesh, India, Pakistan and Sri Lanka



Second quarter was different from the first quarter. Until the end of April Bangladesh, India and Sri Lanka almost followed a same path but Bangladesh and India were little more volatile. In the May surprisingly India's volatility went up drastically and remained high for the period. On the other hand volatility of Bangladesh behaved oppositely from India for the rest of the period. When India went high Bangladesh went down in the mid May and then gradually the volatility rose and fell slowly. Pakistan Sri Lanka remained the same as first quarter. The volatility of Bangladesh went up suddenly at the beginning of May, after very short period it jumped again

and smoothly went down with slight rise in the end. Like the previous quarter Indian volatility acted oppositely to Bangladesh. It stayed above Bangladesh throughout July and gradually moved downward for the period. Pakistan as usual stayed at top but had few rise in the volatility in the beginning of August and September.

Quarter four shows a completely different scenario where Bangladesh is the most volatile country with frequent up and down movements. It started period high then slowly went down till mid-October. After that it maintained a strong upward trend with couple of sharp hikes in November then it smoothly went down. The Indian volatility on the hand was surprisingly flat throughout the quarter, where in the first half of the period it stayed above Bangladesh and then next half it stayed below. The volatility of Pakistan in this quarter was very flat except the small hike in the end.

6.3 Kupeic Test Results

The two sided Kupeic test was conducted with 95% confidence interval for expected violations to check whether observed violations fall within this interval. The minimum and maximum limits are 0 and 7 respectively for the four quarters and 7 and 20 are for the whole year 2014. The accepted violations are represented with green and rejected violations with red color.

From table 3 it is noticeable that three different VaR estimates for all the four quarters have been accepted as all the violations were within lower and upper limit 0 and 7 respectively. The scenario is completely different when it comes to yearly test. Only VaR with EWMA volatility has passed the Kupeic test. Other two estimates were rejected because they both have 5 violations which less than the lower limit of 7.

Table 3: Kupeic test of VaR estimates with three variances for Bangladesh

Quarters	Minimum	Maximum	EWMA	STANDARD DEVIATION	GARCH
Quarter 1	0	7	3	0	0
Quarter 2	0	7	3	0	0
Quarter 3	0	7	1	1	1
Quarter 4	0	7	4	4	4
2014	7	20	11	5	5

Four countries VaR with EWMA volatility was tested following the same procedure used for Bangladesh. The upper and the lower limit for the quarters and the year 2014 are same like table 4. From the table 4 it is noticeable that four countries VaR violations are between 0 and 7 lower and upper limits respectively. For the quarterly violations four countries passed Kupeic test. Interestingly only Bangladesh passed the Kupeic test as it scored 11 violations which is within range. Three other countries India, Pakistan and Sri Lanka failed the test as they all scored 1, 0 and 6 respectively which are less than the lower limit of 7.

Table 4: Kupeic test of VaR estimation for Bangladesh, India, Pakistan and Sri Lanka

Quarters	Minimum	Maximum	Bangladesh	India	Pakistan	Sri Lanka
Quarter 1	0	7	3	0	0	3
Quarter 2	0	7	0	0	0	1
Quarter 3	0	7	1	1	1	0
Quarter 4	0	7	0	0	1	2
2014	7	20	11	1	2	6

6.4 IVaR & CVaR Results & Analysis

So far we have done the individual country analysis but to get deeper understanding we need to include portfolio analysis with IVaR. The IVaR gives the amount or percentage of risk which is produced by an addition of countries. Then we have CVaR which decomposes portfolio risk into individual countries risk.

Table 5: IVaR estimation from two portfolios

Portfolios	Portfolio VaR
VaR (V)	1.04%
VaR (V+a)	0.97%
IVaR	-0.07%

First portfolio mentioned as VaR (V) contains three countries except Bangladesh generated 1.04% risk (Table 5). This is expressed in relative terms, which means portfolio VaR V has chances of losing 1.04% of the portfolio investment $ 1 million. The second portfolio VaR (V+a) is the summation of the first portfolio plus Bangladesh. The result of the second portfolio is 0.97% which less than the first portfolio. From the table 6 it stands at this point that IVaR is -0.07% which is basically the difference between the two portfolios. Interestingly the incremental VaR is negative, which explains instead of increasing the risk Bangladesh reduced the portfolio VaR.

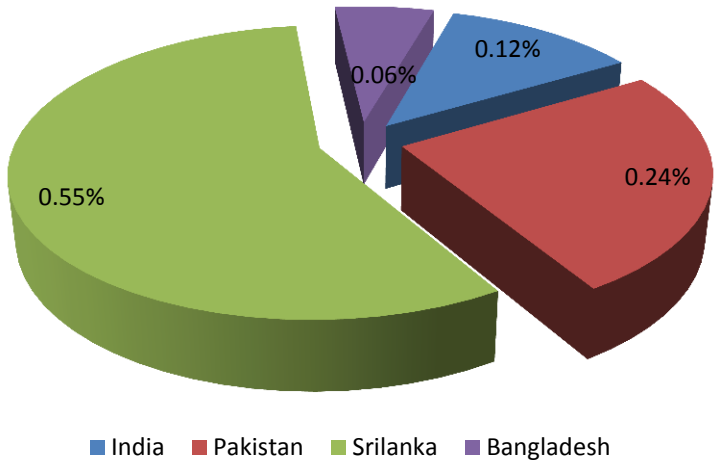
As we know from the theory CVaR breaks down the portfolio VaR and presents individual assets risk contribution. In table 6 we have noticed the VaR (V+a) generated 0.97% risk of losing. From table 6 we see that the second portfolio is separated into four parts or four countries risk

Table 6: Decomposition of portfolio VaR by CVaR in four countries

CVaR	Percentage
India	0.12%
Pakistan	0.24%
Sri Lanka	0.55%
Bangladesh	0.06%
Total	**0.97%**

contribution. Each part tells how much it contributed to the portfolio VaR (V+a). Bangladesh has contributed the lowest percentage to portfolio risk. Bangladesh generated only 0.06% risk. Sri Lanka is at the top with 0.55% risk contribution which is more than half of the total risk. Second position goes to Pakistan as it generated 0.24% risk and India in at third place with risk 0.12%. The summation of all the four risks equals to 0.97% which is the portfolio risk of VaR V+a.

Figure 4: Component VaR of Bangladesh, India, Pakistan and Sri Lanka



Summing up from the results and analysis that Bangladesh has been found less risky than India and Pakistan from the individual risk comparison. In the portfolio risk analysis it was the lowest contributor to the portfolio risk as well as reduced the risk of it.

7. Conclusion

The aim of the study was to find out the riskiness of Bangladesh and the role of it in the SSARC region. Data was collected to estimate VaR for Bangladesh, India, Pakistan and Sri Lanka which best represents SAARC. Evidence descriptive statistics showed fair amount of excess kurtosis in collected data and in some cases it was extreme. The parametric approach Student t-distribution was used, which can best handle fat tail than normal distribution. One day VaR was estimated for the year 2014. Student t-distribution with EWMA variance fitted the data well as it passed the Kupiec test. Comparing Bangladesh with the three other countries showed it remained second lowest risky country among the four countries. The annual average also indicates that it is the second lowest risky country for investment.

To get deeper insight a portfolio analysis of risk was conducted involving IVaR and CVaR. Both are very efficient to tools for portfolio risk analysis, IVaR estimates risk incurred by adding new assets to the existing portfolio and CVaR estimates each assets contribution to the portfolio risk. The IVaR found in the estimation was negative (-0.007) which means Bangladesh is a hedge for this portfolio. It also indicates that Bangladesh reduced the portfolio risk from 1.04% to.97% rather than increasing. The CVaR showed Bangladesh is the lowest contributor with .06% to the total portfolio VaR of 0.97%. All the results and evidence of this study shows that Bangladesh has the lowest market risk than India and Pakistan and it will play a vital role in the SAARC region.

The scholars explained the capital markets of SAARC countries with high volatility, low market capitalization, less international exposure and limited financial instruments. From the results

analysis of this dissertation we can agree with the fact that markets were highly volatile like Pakistan and India. We also disagree that Bangladesh is highly volatile compared to Pakistan and India. We agree with Metzger (2010) that countries like Bangladesh and Pakistan experienced high growth almost and doubled their market capitalization by 2014. It was evident that all the markets except India were heavily dependent on equity and had less diversity in financial instruments.

The capital market of Bangladesh turned out to be the stock exchange with less market risk among SAARC countries except Sri Lanka. It is doing excellent job by restructuring and upgrading to advanced trading system. It's not far behind of being South Asia's one of the most important markets. But to gain that position it still needs to take few initiatives. It must establish a strong monitoring and regulatory authority, include industry based indexes, make available at least past twenty years market data and ease the regulation for the international investors.

Inclusion of Bangladesh into Goldman Sachs Next 11 emerging economies and also the upcoming investment makes Bangladesh very competitive. So based on all the research and evidences we conclude that from risk perspective Bangladesh is going to be a lucrative market for investment compared to other SAARC countries especially India and Pakistan.

References

Ahsan, A. M., Gani, M. O., & Hasan, M. B. (2012). Margin requirements and stock market volatility in Bangladesh. SDMIMD Journal of Management, 3(2), 29-42. Available at: researchgate.net

Ahmed, N. (2013). Bangladesh among next 11 economies: Goldman Sachs. The Financial Express. VOL 21 NO 8 REGD NO DA 1589. Collected on 4/11/2015. Available at: http://www.thefinancialexpress-bd.com/2013/11/18/4543

Berg, A., Hedrich, S., Kempf, S., & Tochtermann, T. (2011). Bangladesh's ready-made garments landscape: The challenge of growth. McKinsey & Company, Inc. Apparel, Fashion & Luxury Practice, 1-24. Available at

Benninga, S., & Wiener, Z. (1998). Value-at-risk (VaR). matrix, 32, s33. Available at: http://simonbenninga.com/wiener/MiER74.pdf

Chen, J. M. (2014). Measuring Market Risk Under the Basel Accords: VaR, Stressed VaR, and Expected Shortfall. Stressed VaR, and Expected Shortfall (March 19, 2014), 8, 184-201. Available at: http://www.ieb.es/wp-content/uploads/2014/07/85.pdf

Duffie, D., & Pan, J. (1997). An overview of value at risk. The Journal of derivatives, 4(3), 7-49. Available at: http://www.ime.usp.br/~ rvicente/risco/duffie.pdf

Döpke, J., Hartmann, D., & Pierdzioch, C. (2005). Forecasting stock market volatility with macroeconomic variables in real time (No. 2006, 01). Discussion Paper, Series 2: Banking and Financial Supervision. Avilable at: http://hdl.handle.net/10419/19749

Dowd, K., 2002. Measuring Market Risk. 1st ed. West Sussex: John Wiley & Sons Ltd.

G. Jullien (2009). Aid for Trade: Profile of the SAARC. CUTS-GRS Background paper. Available at: www.cuts-geneva.org/pdf/Aid_for_Trade-Profile_of_the_SAARC.pdf

Goldman Sachs Asset Management. Next Eleven Economies. Available at: http:/ / www.goldmansachs.com/gsam/docs/funds_ international/brochures _ and _sales_ aids/fund_ literature/advisor_brochure_n-11_en.pdf

Hossain, S. (2013). The Impulsive Stock Market of Bangladesh and the Great Recession. International Journal of Business and Social Research, 3(3), 126-139.

Hassan, M. K., Islam, A. M., & Basher, S. A. (2000). Market efficiency, time-varying volatility and equity returns in Bangladesh stock market. Applied Financial Economics, 6. Available at: http://www.econ.yorku.ca/research/workingPapers/ working_papers/DSE.pdf

Hasan, M. B., Alam, M. N., Amin, M. R., & Rahaman, M. A. (2014). The Size and Value Effect to Explain Cross-Section of Expected Stock Returns in Dhaka Stock Exchange. International Journal of Economics and Finance, 7(1), p14. Available at: ccsenet.org

Jorion, P. (1996). Risk2: Measuring the risk in value at risk. Financial Analysts Journal, 52(6), 47-56. Available at: http://merage.uci.edu/~jorion/papers%5C Jorion-1996-FAJ.pdf

Linsmeier, T. J., & Pearson, N. D. (1996). Risk measurement: An introduction to value at risk. Available at: http://www.casact.net/education/specsem/99frmgt/ pearson2.pdf

J. P. Morgan, (1997). Creditmetrics-technical document. JP Morgan, New York. Available at: http://www.creditrisk.ru/publications/files_attached/creditmetrics_ techdoc.pdf

Metzger, M. (2010). Trends in Financial market development in South Asia. New Delhi, India. Online available at:⟨ http://www. icrier. org/pdf/Martina% 20Metzger-Pa per. pdf.

Mandelbrot, B. B. (1997). The variation of certain speculative prices (pp. 371-418). Springer New York. Available at: http://e-m-h.org/Mand63.pdf

Romero-Torres, J., Wells, S., & Selwyn-Khan, S. (2013). Development of Capital Markets in Member Countries of the South Asian Association for Regional Cooperation.

Rahman, M. T., & Moazzem, K. G. (2011). Capital market of Bangladesh: Volatility in the Dhaka Stock Exchange (DSE) and role of Regulators. International Journal of Business and Management, 6(7), p86. Available at: http://www.ccsenet.org/ijbm

Sarker, M. M., Nargis, N. (2012). Identifying the Critical Issues of Stock Market: A Study on Dhaka Stock Exchange (DSE). IJAR BAE, 1(3), 48-55.

Shahidul-Islam, M., & Jahan, S. (2012). Analysis of Financial Products of Capital Market in Bangladesh: Present Status and Future Development. International Journal of Marketing Studies; Vol. 4, No. 5; 2012. Available at: http://www.ccsenet.org/journal/index.php/ijms/article/view/16412

Appendix

Column1	India	Pakistan	Sri Lanka	Bangladesh	Total Investment
Investment	**200000**	**300000**	**500000**	**100000**	
Weight (V)	0.2000	0.3000	0.5000		**1000000**
Weight (V+a)	0.1818	0.2727	0.4545	0.0909	**1100000**

Table A.1: Investment and weight for individual countries and portfolios

Column1	India	Pakistan	Sri Lanka	Bangladesh
Mean	0.0004	0.0006	0.0006	0.0002
St. Deviation	0.0103	0.0102	0.0098	0.0176
Variance	0.0001	0.0001	0.0001	0.0003
Beta	0.6652	0.9091	1.2514	0.6852

Table A.2: Mean, Standard Deviation, Variance and Beta of individual countries

Countries	India	Pakistan	Sri Lanka	Bangladesh
India	1			
Pakistan	0.101762325	1		
Sri Lanka	0.088638717	0.096839599	1	
Bangladesh	-0.047632178	0.003380073	-0.006042683	1

Table A.3: Correlation matrix of Bangladesh, India, Pakistan and Sri Lanka

Portfolio	Values
Mean (V)	0.000549
Mean (V+a)	0.000522
Variance (V)	0.000044
Variance (V+a)	0.000039
Std. (V)	0.006628
Std. (V+a)	0.006208

Table A.4: Portfolio mean, variance and standard deviation of the four countries