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# Efficiency and Volatility of the Stock Market in Bangladesh: A Macroeconometric Analysis

Hasan, Md. Abu

University of Rajshahi

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**EFFICIENCY AND VOLATILITY OF THE STOCK MARKET IN  
BANGLADESH: A MACROECONOMETRIC ANALYSIS**

Ph.D. Dissertation

**MD. ABU HASAN**

Session: 2012-13



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**Institute of Bangladesh Studies (IBS)**

University of Rajshahi, Bangladesh

November 2015

**EFFICIENCY AND VOLATILITY OF THE STOCK MARKET IN  
BANGLADESH: A MACROECONOMETRIC ANALYSIS**

Ph.D. Dissertation

Submitted to the Institute of Bangladesh Studies (IBS), University  
of Rajshahi for the degree of Doctor of Philosophy in Economics

**MD. ABU HASAN**

Under the Guidance of

**Professor Md. Abdul Wadud**

Ph.D. (Newcastle, United Kingdom)

Department of Economics

University of Rajshahi, Bangladesh



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**Institute of Bangladesh Studies (IBS)**

University of Rajshahi, Bangladesh

November 2015

## Abstract

This dissertation investigates the weak form efficiency of Efficient Market Hypothesis (EMH) employing Autocorrelation test, Runs test and Unit Root tests, and the nature of volatility characteristics of stock returns applying GARCH family models in Bangladesh stock market using daily all share price index return data of Dhaka Stock Exchange (DSE) from 02 January 1993 to 27 January 2013. The thesis also examines the semi-strong form of the EMH of DSE based on macroeconomic variable version of the Arbitrage Pricing Theory (APT) applying Cointegration tests, Vector Error Correction Model (VECM) and Granger causality tests, and the volatility of the DSE returns in response to the volatility of the macroeconomic variables employing GARCH family models using monthly data from January 2001 to December 2012. In addition, the short run and long run relationships between macroeconomic variables and aggregate stock prices in Bangladesh have also been determined.

Employing both nonparametric tests (Runs test and Phillips-Perron test) and parametric tests (Autocorrelation test and Augmented Dickey-fuller test), this thesis finds that the Dhaka Stock Exchange of Bangladesh is not weak form efficient. The Johansen and Juselius multivariate cointegration tests reveal that industrial production index (IPI) and crude oil price (OP) have significant negative long run relationships with all share price index (DSI) of DSE, while money supply (MS), exchange rate (ER) and Indian stock prices (SENSEX) have significant positive long run relationship with all share price index of DSE. Results of VECM indicate that there is a long run causality running from IPI, M2, OP, ER and SENSEX to DSI. The error correction term of first differenced DSI implies that 15% of the last month's disequilibrium becomes corrected monthly. The VECM results also show that DSI picks up the disequilibrium quickly and guides the variables of the system back to equilibrium. Results of VECM Granger causality/block exogeneity Wald test and Granger causality test reveal that individually IPI, CMR and SENSEX are the leading indicators with respect to stock prices in Bangladesh in the short run. Moreover, stock price index of DSE is a leading indicator with respect to IPI and ER in the short run. Taking the outcome of VAR models into account, it is found that all selected macroeconomic variables do significantly explain

the stock prices of the Bangladesh stock market. As a consequence, it may be concluded that the Bangladesh stock market is not efficient in the semi-strong form of EMH.

Results of the estimated MA(1)-GARCH(1,1) model show that the stock market of Bangladesh captures volatility clustering and the volatility is moderately persistent. The estimated MA(1)-EGARCH(1,1) model reveals that the effect of bad news on stock market volatility is greater than the effect induced by good news. Results of six GARCH-S models indicate that there is significant positive relationship between the changes in exchange rate (ER) and the volatility of DSE returns. Results also imply that the growth of the broad money supply (M2) and the volatility of Indian stock market (SENSEX) have significant negative relationship with the volatility of Dhaka stock exchange returns.

Therefore, we can conclude that the stock market of Bangladesh is not efficient in weak and semi-strong form, and consequently, investors can earn abnormal profit using publicly available information. Stock market returns of Bangladesh exhibit leptokurtosis, volatility clustering and leverage effect or asymmetric volatility. The volatility of DSE return is significantly influenced by the volatility of macroeconomic variables such as ER, M2 and SENSEX.

## Declaration

I do hereby declare that this thesis titled 'Efficiency and Volatility of the Stock Market in Bangladesh: A Macroeconometric Analysis' submitted by me to Institute of Bangladesh Studies (IBS), University of Rajshahi, Bangladesh for the degree of Doctor of Philosophy in Economics is an original research work under the supervision of Dr. Md. Abdul Wadud, Professor, Department of Economics, University of Rajshahi, Bangladesh. To the best of my knowledge and belief, this thesis contains no material previously published or written by another person except where due reference is made and the work presented in it is my own. This work has not been submitted, and will not be presented at any other University in a similar or any other degree.

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Signature of the Candidate

Full Name: **Md. Abu Hasan**

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## Certificate

This is to certify that this thesis titled ‘Efficiency and Volatility of the Stock Market in Bangladesh: A Macroeconometric Analysis’ has been prepared by Md. Abu Hasan, Ph.D. Fellow, Session: 2012-13, Institute of Bangladesh Studies (IBS), University of Rajshahi, Bangladesh under my direct supervision and guidance. The whole thesis comprises the own work and personal achievement of the researcher.

I have gone through the thesis and recommend that the thesis be submitted for award of the degree of Doctor of Philosophy in Economics.

---

**Professor Md. Abdul Wadud**

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A decorative border resembling a scroll, with rounded corners and a grey shaded area at the top-left and bottom-left corners.

## **Dedication**

This thesis is dedicated to my precious parents

**Fatima-Tuj-Zohra** and

**Md. Abdul Khaleque Molla**

for their constant support, attention and inspiration to achieve my dreams.

And a special dedication must be made to my lovely wife

**Anita Zaman**

for her continued encouragement.



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I express my thankfulness to the authorities of the Institute of Bangladesh Studies (IBS), University of Rajshahi, Bangladesh for providing me a research fellowship and necessary infrastructure for doing this work. I would like to take this opportunity to thank all of the respected teachers and staff of IBS for their help and support through my journey at IBS. In particular, I would like to express my gratitude and appreciation to former Director of IBS, Professor Dr. Md. Shahidullah, present Director of IBS, Professor Dr. Swarochish Sarkar, respected teachers of IBS named, Dr. M Zainal Abedin, Dr. Mustofa Kamal, Dr. Jakir Hossain, Dr. Mohammad Najimul Hoque and Dr. Md. Kamruzzaman for their constant guidance and effective teaching. I am thankful to the University Grants Commission (UGC), Bangladesh for granting me the UGC fellowship. I am similarly thankful to the Ministry of Education, and Directorate of Secondary and Higher Education, Bangladesh for granting me the necessary leave.

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## **Abbreviations**

ACF: Autocorrelation Function

ADF: Augmented Dickey-Fuller Unit Root Test

AIC: Akaike Information Criterion

APT: Arbitrage Price Theory

ARCH: Autoregressive Conditional Heteroskedasticity Model

ARIMA: Autoregressive Integrative Moving Average Model

ASE: Athens Stock Exchange

BB: Bangladesh Bank

BO: Beneficiary Owner

BSE: Bombay Stock Exchange

BSEC: Bangladesh Securities and Exchange Commission

CAPM: Capital Asset Pricing Model

CDBL: Central Depository Bangladesh Limited

CSE: Chittagong Stock Exchange

ECM: Error Correction Model

DAX: The Major German Stock Index

DGEN: General Index of Dhaka Stock Exchange

DSE: Dhaka Stock Exchange

DSEX: Broad Index of Dhaka Stock Exchange

DSI: All share Price Index of Dhaka Stock Exchange

EGARCH: Exponential GARCH

EMH: Efficient market hypothesis

ER: Exchange Rate

FPE: Final Prediction Error Criteria

FY: Fiscal Year

GARCH: Generalized Autoregressive Conditional Heteroskedasticity Model

GDP: Gross Domestic Product

GNI: Gross National Income  
HQ: Hannan-Quinn Information Criterion  
ICB: Investment Corporation of Bangladesh  
IRF: Impulse Response Function  
INR: Inflation Rate  
JJ: Johansen-Juselius Cointegration Approach  
KPSS: Kwiatkowski, Phillips, Schmidt, and Shin Unit Root Test  
KSE: Karachi Stock Exchange  
LR: Long Run  
M1: Narrow Money Supply  
M2: Broad Money Supply  
MoF: Ministry of Finance  
PP: Phillips-Perron Unit Root Test  
QLB: Ljung-Box Q test  
SR: Short Run  
SIC: Schwarz Information Criterion  
USSR: Union of Soviet Socialist Republics  
VAR: Vector Autoregressive  
VECM: Vector Error Correction Model  
VDC: Variance Decompositions

# Chapter 1

## Introduction

### 1.1 Introduction

As a source of long term financing, the stock market plays a significant role to accelerate the industrial development of an economy. The stock market is one of the engines of economic growth because not only it acts as a bridge between savers and investors in the course of savings mobilization and investment fund allocation, but also entrepreneurs continuously face enormous pressure from the shareholders to do well in business by using that capital. The stock markets of developed countries get more attention to allocate the required capital for the consistent growth of their economy, while contributions of the stock market are lately acknowledged among the developing countries. Financial sector of Bangladesh, like most developing countries, is dominated by banking sector that is practically appearing close to the crisis caused by massive nonperforming loans and huge volume of classified and default loans despite of a series of reform initiatives over the years. The amount of total nonperforming loans in the banking system of Bangladesh was Tk. 523.1 billion at the mid of 2013, which was Tk. 427.3 billion in 2012 and Tk. 200.1 billion in 2006 (Lata, 2014). Thus, the stock market may be a complementary financial system with the banking sector in a growing economy like Bangladesh as Garcia and Liu (1999), and Dima, Dincă and Spulbăr (2014) uncover that capital markets' development supports a stable evolution in the banking sector. Levine (1991), Levine and Zervos (1996), Olweny and Kimani (2011), *among others*, argue that stock market development contributes substantially to the economic growth of a country both directly and indirectly. Unlike Haque and Fatima (2011), Hossain and Kamal (2010) reveal that the stock market development strongly influences the economic growth in Bangladesh economy. It is well-established that share market has become a major economic barometer not only in a capitalist economy but also in a socialistic economy. Even the former USSR recognized this vital function performed by stock exchanges of the development of its economy (Sachdeva, 1994). So, well functioning emerging capital markets are expected to accelerate economic growth by increasing savings, investment and making global risk diversification easier

for investors. A stock market is said to be emerging market which: (i) is located in a country with low and middle income as defined by the World Bank; (ii) has a low market capitalization relative to the country's Gross National Income level; (iii) has few restrictions on foreign investment (Standard and Poor's, 2009). So, the stock markets in Bangladesh satisfy the definition of an emerging market. Therefore, the stock market has a crucial role to play to make a strong industrial base of emerging markets like Bangladesh, whose economy is progressing rapidly since the last two and half decades.

Efficiency and volatility have been the most active and successful area of research in time series econometrics and finance in past three decades. The efficient markets theory assumes that stock prices reflect all available information like past stock price patterns, company and economy fundamentals. Therefore, prediction on future stock prices should be a worthless task in an efficient stock market by looking at past price patterns, company and economy fundamentals. Theoretically, the stock market should be closely related to real economic variables of the country. Based on a simple discount model, if the fundamental value of a corporate stock is equal to the present value of expected future dividends, the future dividends must eventually reflect the real economic activity. So, information on the connection between micro and macroeconomic variables (macroeconomic factors like interest rate, inflation rate, exchange rate and money supply, and microeconomic factors like price-earnings ratios, market capitalization, trading volume and dividend yield), and stock prices is decisive to the investors in the equity market as well as to the policy makers. Both equally specialized and amateur investors try to predict on future market activity day after day. Investors have an immense interest in discovering variables that may help forecast stock prices to make decisions on their stock portfolio for maximum gains. On the other hand, policymakers pay concentration on the relationship because they can better control the direction, extent and stability of the economy by adjusting real economic variables. If the connection between stock prices and micro-macroeconomic variables exists, the stock market of Bangladesh loses its informational efficiency and becomes more volatile. The role of economic factors and past stock price patterns on the stock prices has been subjected to economic research all over the world. Although, study like efficiency and volatility of the stock market in Bangladesh in response of macroeconomic variables has basically been ignored.

This study takes an attempt to discover the issue of efficiency and volatility of the stock market in Bangladesh by employing both univariate models using daily past share prices data and multivariate models employing monthly data of macroeconomic variables and stock index. There are four strong logics to prefer the top-down approach to stock market behavior analysis. First, top down approach is a macroeconomic analysis of investing in the stock market. Crescenzi (2009) illustrates several points in favor of top down approach to stock market analysis and argues that golden age for macroeconomics has arrived, and top down analysis has become a must acceptable tool to study stock market behavior due to globalization. The stock market and its relationship with monetary and fiscal policy, wealth effect, market sentiment and sector analysis, among others have been sincerely focused by electronic and print media. Bottom up analysis like individual stock related microanalysis is too much time-consuming for the investors who need to focus on many other works every day. That is why, investors are shifting towards top down analysis instead of bottom up analysis. Second, the aggregate share price named stock price index is a macroeconomic variable. Therefore, performance analysis like efficiency and volatility in stock prices should be more effective with macroeconomic framework. Third, the stock market can be affected by macroeconomic variables through the effect of the demand of shares. Demand and supply analysis, under the price mechanism implies that supply of shares is fixed, i.e., inelastic on profit or interest rate; however, demand of shares is elastic and depends on the determinants like interest rate, GDP, industrial production index and inflation rate (Erdugan, 2012). Hence, the price mechanism connects the economic markets such as product market, labor market, money market, capital market, resources market, foreign exchange market, and foreign market, and obviously variables of those markets must have some influence on the variables of share market. Fourth, asset pricing theories of asset valuation model have constructed as well based on the demand side of the stock market.

This thesis may lead the way for Bangladesh perspective attempting to use top down approach to test both efficiency and volatility of Dhaka Stock Exchange aggregate stock prices from the joint viewpoint of the Efficient Market Hypothesis (EMH) and a macroeconomic version of the most prominent equilibrium asset pricing model named the Arbitrage Pricing Theory (APT).

## 1.2 Statement of the Problem

Al-Jafari et al. (2011) explore that over the past several decades, emerging countries have experienced persistent and high rates of economic growth. They also comment that while many factors explain economic growth, trade and capital market liberalization have played an important role. The World Bank (2013) denotes that Bangladesh has sustained an impressive track record of growth and development. The stock market of Bangladesh has progressed accompanied by the overall economy after the process of liberalization in early 1990s. Stock markets of Bangladesh are relatively new compared to other emerging countries; however it obtains an immense focus by policymakers, investors, academicians, and even general citizens. Taking into consideration the facts, the study aims to explore the behavior of the Bangladesh stock market.

Stock or share is the smallest part of ownership of an asset. The stock exchange is an organization to ease buyer and seller to buy and sell listed securities. The stock market is well-known as a comparatively cheap source of funds contrasted with the money market. Equally, the government and the private sectors would have in need of long-term capital for the setting up infrastructures, build new factories or buy new machineries at any stage of a nations' advancement that is usually financed by a well-functioning stock market. Stock markets of Bangladesh are not being a steady market. For a while, market index increases continuously and accordingly the prices of stock become extremely sky-scraping and investors get pleasure from abnormal profit. In contrast, at times, the market falls hugely and thus investors acquire loss. Thus, it is important to explore the performance of the stock market of Bangladesh by determining the level of volatility and efficiency based on the actions of historical stock prices and economic variables. Informational efficiency, i.e., market efficiency is the measure of how quickly and accurately the market reacts to new information. Volatility measures how the present price of an asset deviates from its average past prices.

Bangladesh has two stock exchanges: Dhaka Stock Exchange (DSE) and Chittagong Stock Exchange (CSE). Dhaka Stock Exchange is the oldest and largest stock exchange in Bangladesh. However, DSE established in 28 April 1954 but its commercial operation started in 1956. Over the years, DSE has become one of the leading emerging

markets in South Asian region. Dhaka Stock Exchange has grown dramatically and gained second place in South Asia as the growth of the ratio of market capitalization to GNI was 925% between 2000 and 2011 (Khan, 2013). DSE is functioning with 535 listed securities (262 companies, 41 mutual funds, 8 debentures, 221 treasury bonds and 3 corporate bonds) with Tk. 2.95 lakh crore of market capitalization at the end of April, 2014 (DSE, 2014). DSE uses three share price indices-DSE All Share Price Index (DSI), DSE General Price Index (DGEN) and DSE-20 before starting Standards & Poor's supported DSE Broad Index (DSEX) and DSE 30 Index (DS30) in 28 January 2013. For the purpose of the study, Dhaka Stock Exchange is considered as the representative of the stock market of Bangladesh and all share price index (DSI) from DSE is considered as it covers most of the stocks in the country. DSE faces two major collapses during the years 1996 and 2010. The index of Dhaka Stock Exchange lost a notable amount of its value and wiped out millions of Taka. DGEN of DSE came down to 700 points in November 1997 from its highest 3600 points in November 1996 (Alam, 2012). As a result, regulators have taken several of steps to stabilize the market. But once again, the market crashed heavily in 2010. The DGEN of DSE came down 3616 points in early February 2012 from 8918 points in December 2010 (Alam, 2012). Moazzem and Rahman (2012) address the problem of the capital market of Bangladesh and argue that not only inefficiency, but also a series of problems are present in the primary and secondary stock markets. Whatever reasons for these incidents, it is evident that some investors can earn abnormal profits, whereas some acquire enormous losses from the capital market. If markets are efficient, then stock prices fully reflect all information present in the market. Though, it is usually believed that developed stock markets are more efficient than developing and underdeveloped market due to flow, adjustment and magnitude of information, the study tries to find out whether the stock prices of Bangladesh are predictable by investors and policymakers. It is also well recognized that volatility characterizes the behavior of the stock market. If the price of a stock fluctuates widely, the volatility will be high; and conversely, if the price variation is low, it has low volatility. Daly (1999) argues that volatility has become an important issue since financial and economic theory introduces the notion that consumers are risk averse. As a result, increased risk associated with a given economic activity should realize a reduced level of participation in that activity, which will have adverse consequences for investment. Nevertheless, the investors of the stock markets generally like to adopt more risk in order to earn more return. So, it goes without saying



that a little bit volatility of stock prices is a good sign of any stock market. Nevertheless, the problem is that the stock market of Bangladesh is an up-and-coming market. The radical unpredictable nature of DSE is the focal dilemma. This abnormal phenomenon may prevent the smooth functioning of stock markets and adversely affect the performance of the economy. Previous studies, like Groenewold and Kang (1993) and Erdugan (2012), *among others*, examine the weak form efficiency using historical share price indices, and the semi- strong efficiency using macroeconomic variables. Mecagni and Sourial (1999), Siourounis (2002), *among others*, test the efficiency and volatility using historical share price indices. Fama (1981 and 1990) and Chen, Roll and Ross (1986) investigate that price volatility in stock market increases owing to the movement of economic variables.

The rising importance of stock markets globalization has increased the interest in emerging markets. Consequently, researchers have focused research on whether or not these markets are efficient. The stock market of Bangladesh has been growing notably for the past two and half decades. Thus, measuring the efficiency of stock market is an important research topic as this contains various implications for investors. Moreover, the stock market crashes enlighten that it is important to protect the stock market from drastic fluctuations. Thus, analyzing the volatility of stock returns is an informative examination as it bears several indications for investors and policymakers. Hence, this research is designed to macroeconomically investigate the efficiency and volatility of stock market in Bangladesh.

### **1.3 Research Questions**

The followings are the leading research questions on the topic of this research:

- i. What is the nature of the stock market efficiency in Bangladesh?
- ii. Do the macroeconomic variables incorporated in this study share short run and long run relationships with the stock prices?
- iii. Are there any causal relationships between stock index and macroeconomic variables? What is the direction of the causality if there is any?

- iv. What kinds of volatility characteristics of stock returns do prevail in the Bangladesh stock market?
- v. Does the volatility of macroeconomic variables influence the stock return volatility?

## **1.4 Objectives**

### **1.4.1 Broad Objective**

The overall aim of this thesis is to explore the effect of historical stock returns on current stock returns, and the impact of economic factors on the stock prices such that we get an idea about the magnitude of efficiency and volatility of Bangladesh stock market.

### **1.4.2 Specific Objectives**

The specific objectives are as follows:

- i. To investigate the efficiency of the stock market in Bangladesh;
- ii. To examine the short run dynamics and long run equilibrium links between economic variables and stock prices;
- iii. To explore the causal relationships and direction of the causality between stock index and macroeconomic variables;
- iv. To assess the volatility characteristics of stock returns;
- v. To investigate the volatility of stock market returns in response to the volatility of the macroeconomic variables.

## **1.5 Significance of the Study**

Since Bangladesh has adapted free market economy as her national policy is to achieve her goals of higher growth and rapid privatization, she must uplift her stock market and make it capable of working as the main vehicle for mobilizing and allocating funds needed to finance industrial and other development activities of the country. In fact, no alternative path is appropriate like a stock market to strengthen the financial base of a country by gearing up its development activities to achieve its all-out economic freedom. Considering the significance of the stock market to the real economy, the

stock market of Bangladesh has obtained attractive attention to the literature in recent times. The study is expected to add several primary contributions to the existing literature.

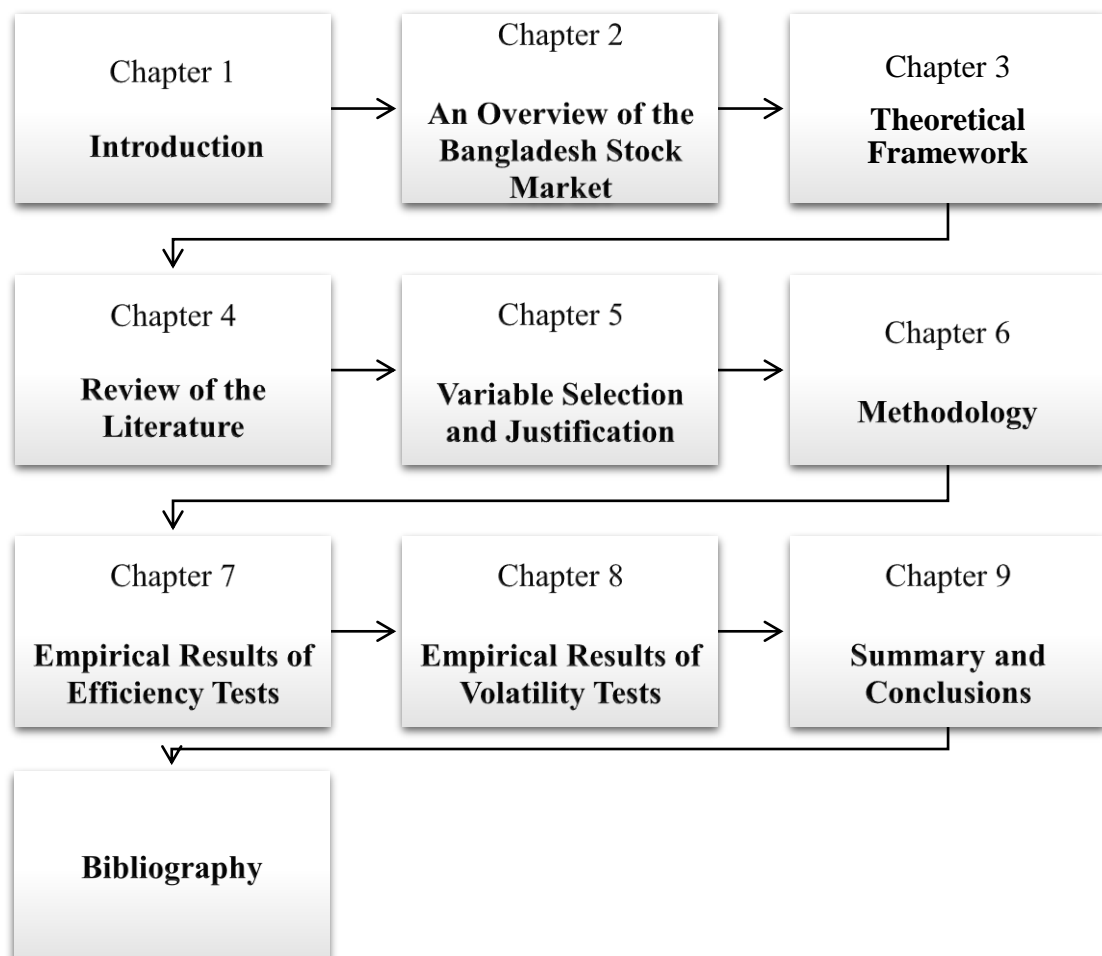
First, quite a few studies have been conducted to test both the efficiency and volatility of the stock market. Most of them have used only historical data of stock index to test efficiency and volatility. Although, bunches of study around the world have been conducted by renowned researchers to find out the relationship between macroeconomic variables and stock prices, but the efficiency and volatility test using a top down approach has basically been overlooked. This study tries to fill the gap in the literature as it attempts to explore the efficiency and volatility of DSE by using both univariate and multivariate time series models. Second, few researches have been conducted in the context of Bangladesh to test weak form of efficiency. This study should be considered as special work because the random walk hypothesis of weak form EMH is tested employing both nonparametric tests (Runs test and Phillips-Perron test) and parametric tests (Autocorrelation test and Augmented Dickey-fuller test). Moreover, semi-strong form of EMH is also tested applying the VAR model using macroeconomic variables based on joint hypothesis testing of EMH and Arbitrage Pricing Theory. Third, this study attempts to investigate the nature of volatility characteristics of stock returns that prevail on the Bangladeshi stock market, and investigates the volatility of the DSE return in response to the volatility of the six macroeconomic variables employing a sophisticated econometric GARCH family model framework. Fourth, this thesis should contribute to the literature because a special set of macroeconomic variables is preferred based on reasons rather than randomly selected variables and the way that the variables affect stock market prices has been identified. Variables from each economic market are selected considering that the economy of Bangladesh follows well-known price mechanism of free market economy. Fifth, this study would widen the existing literature as local and global macroeconomic variables are used to predict whether the Bangladeshi stock market is motivated mainly by domestic macroeconomic factors, or global stock markets have some influence on it. Moreover, it explores the long run equilibrium and the short run dynamic links between economic variables and aggregate stock prices of Bangladesh by using a new set of data that are analyzed with a series of econometric models.

Finally, the results of the study should give some new references to the private investors, institutional investors, and policymakers about the critical issues of the stock market in Bangladesh. Therefore, the overall contributions of this study should positively affect the Bangladesh economy, as thorough investigations of stock price behavior employing modern econometric techniques give valuable knowledge to investors to allocate their portfolio efficiently and policy makers to regulate existing policies or implement new policies to attract more investments.

## 1.6 Structure of the Thesis

The thesis comprises of nine Chapters as shown in Figure 1.1.

**Figure 1.1: Structure of the Thesis**



The remainder of the thesis is organized as follows. Chapter 2 provides some facts on the performance of the Bangladesh economy and thereafter the overview of the financial system of Bangladesh. In particular, this Chapter outlines a context for the remainder of the thesis. The Chapter further discusses a historical review of the development stages of the Bangladesh stock market since its inception in 1954. A statistical review of the performance of Dhaka Stock Exchange from 1991 to 2012 is also evaluated based on the market activity, market size, and market liquidity. Finally, the status of DSE in the world stock market perspective is also uncovered in the Chapter.

The theoretical asset pricing models and empirical studies are reviewed in Chapter 3 and 4 respectively with the intention of giving a broad overview of the topic. Chapter 3 summarizes the theoretical framework such as the Efficient Market Hypothesis (EMH) and the theory of asset pricing such as Portfolio Theory, Capital Asset Pricing Model (CAPM), Present Value Model (PVM) and Arbitrage Pricing Theory (APT).

Chapter 4 reviews the empirical studies that have employed various quantitative methods to examine the theories in developed, emerging and as well as Bangladesh stock markets. In particular, the Chapter discusses the empirical researches that have examined the weak form of the EMH, semi-strong form of the EMH, stock market volatility, and the relationships between various macroeconomic variables and share prices in developed, developing and as well as Bangladesh stock markets.

In Chapter 5, a set of variables is identified after appropriate scrutiny. Upon appropriate validation process, the variables are hypothesized and also discussed the measurement procedure before considering them in the models for empirical analysis.

The methodology and methods underpinning the research in the current thesis are outlined in Chapter 6. Specifically, the Chapter presents an explanation of how modern econometric techniques can be employed to understand the behavior of Bangladesh Stock Market. A set of financial econometric methods such as autocorrelation test, run test, unit root tests, cointegration, vector error correction, Granger causality, GARCH (p,q), EGARCH, and GARCH-S models are discussed in the Chapter.

Chapter 7 presents the empirical analysis of the efficiency tests, which examines the weak form of EMH, semi-strong form of the EMH, and the long run equilibrium relationships and short run dynamic linkages between stock prices and macroeconomic variables.

Chapter 8 offers the empirical analysis of the volatility models, which in the beginning reports the results of the univariate volatility models in order to assess the stylized facts of stock returns prevailing in the Bangladesh stock market using daily closing stock prices over a span of 20 years. Then the Chapter presents the results of the multivariate volatility models in order to estimate whether the volatility of the macroeconomic variables incorporated in this study have any impact on stock market volatility in Bangladesh using monthly data of the variables over a span of 12 years.

Finally, Chapter 9 concludes the thesis. This Chapter summarizes the main findings of this study. The Chapter also provides suggestions for future research on this topic. In the end, it presents some policy implications related to the findings of this study.

## **1.7 Conclusion**

This Chapter familiarizes the reader to the remainder of this thesis. It gives some light on the motivation and the significance of the research. In addition, the Chapter specifies a road map to guide the reader on the structure and content of the thesis. In particular, it highlights that the thesis concentrates on five specific objectives. The study investigates the weak form efficiency and the nature of volatility characteristics of stock returns in the Bangladesh stock market using daily all share price index return data of Dhaka Stock Exchange from 02 January 1993 to 27 January 2013. In addition, the thesis examines the semi-strong form of the EMH and the volatility of the DSE return in response to the volatility of the macroeconomic variables with an equilibrium asset pricing model named APT using monthly data from January 2001 to December 2012. Moreover, the relationships between macroeconomic variables (domestic and international) and aggregate stock prices in Bangladesh are determined.

## **Chapter 2**

### **An Overview of the Bangladesh Stock Market**

#### **2.1 Introduction**

After highlighting the background, intention and structure of this thesis in Chapter 1, this Chapter introduces an overview of the Bangladesh stock market. Bangladesh is located on the Bay of Bengal and is bordered by two countries, India and Myanmar. It formerly was a part of Indian subcontinent and later Pakistan in 1947. After 23 years of social and economic discrimination by West Pakistan, Bangladesh has emerged as an independent nation in 1971 with the cost of two decades political struggle and a nine month War of Liberation with the Pakistan army. Bangladesh is one of the most densely populated countries of the world with a population of 160 million in a land mass of 147,750 square kilometers. Over the past 43 years since independence, Bangladesh has increased its real per capita income by more than 130%, cut the poverty rate by 60%, and is well set to achieve most of the millennium development goals in spite of frequent natural disasters, political instability, and global financial crisis. Aside from this past progress, Bangladesh is still a lower-middle income country and aspires to be a middle-income country by 2021.

In view of the facts that this thesis involves in studying the efficiency and volatility in the Bangladesh stock market, it is essential as well as meaningful to present some relevant aspects about the Bangladesh economy, her stock markets and changes that have taken place within it since the country became independent. For that reason, we first state some facts on the performance of the Bangladesh economy in section 2.2, and thereafter the overview of the financial system of Bangladesh in section 2.3. Subsequently, section 2.4 presents a historical review of the development stages of the Bangladesh stock market since its inception in 1954. A statistical review of the performance of the stock market and the status of DSE in the world stock market perspective are also provided in section 2.5 and 2.6 respectively. Finally, section 2.7 organizes conclusion of the Chapter.

## **2.2 Bangladesh as an Emerging Market Economy**

With an inherited fragile economy after independence in 1971, Bangladesh has categorized as a poor economy and branded as a natural disaster inflated, famine, and devastating economy in the world. Henry Kissinger, who was the former US Secretary of State labelled Bangladesh as ‘bottomless basket’ dependent on foreign aid. Bangladesh has taken more than twenty years to disprove the statement as she witnessed decades of slow economic growth until 1990s. The performance of Bangladesh economy over the last one and half decades has been quite impressive. The country has posted an average annual GDP growth rate of about 4% in the 1970-80s, which improved to 5% in the 1990s. During the first decade of the 21<sup>st</sup> century, the average economic growth rate has been approached 6% per annum. Bangladesh has made substantial progress of reducing poverty, where the percent of the population living below the poverty line went down from more than 80% in early 1970s to 31.5% in 2010-11 Fiscal Year (FY). Some of the core particular successes include, reducing the total fertility rate from 7.0 to 2.7, increasing life expectancy from 46.2 years to 66.6 years, increasing the savings and investment rates from below 10% each in the 1970s to 24% (investment rate) and 30% (savings rate) in FY 2010 and thereby achieving near self-sufficiency in food (Ministry of Planning, GoB, 2011, p. 1). That is why, The World Bank has signposted on its website that:

‘Bangladesh has sustained an impressive track record for growth and development. In the past decade, the economy has grown at nearly 6 % per year despite frequent natural disasters and fuel, food price and global financial crises. In the past two decades, poverty was reduced by nearly one-third whereas life expectancy, literacy and per capita food production have increased significantly’. (2013, para. 1)

Currently, Bangladesh is the 31<sup>th</sup> largest economy in the world in terms of purchasing power parity (Sohel, 2015). Bangladesh is practically self-sufficient in food and is a major exporter of garments, leather, ceramics and pharmaceuticals. Bangladesh is now recognized as an emerging economy and frequently captured by reputed international organizations and media. According to the study by PwC (a UK-based global consulting firm) in early 2015, Bangladesh is among eight newly emerging economies to be



included in the latest update of its “World in 2050” report for indicating signs of sustained rapid growth in the long term (Kibria, 2015). According to the study, Bangladesh is projected to become 23<sup>rd</sup> biggest economy in the world in next 35 years. In 2005, US investment Bank, Goldman Sachs included Bangladesh in ‘The Next-11’ as one of the most promising economies with a high potential of becoming the world’s largest economies in the 21<sup>st</sup> century after the BRICS nations. BRICS is the five countries-Brazil, Russia, India, China, and South Africa, while The Next Eleven is the eleven countries – Bangladesh, Egypt, Indonesia, Iran, Mexico, Nigeria, Pakistan, the Philippines, Turkey, South Korea, and Vietnam. According to a report of Investor’s Chronicle in 2008, a UK-based research firm, Bangladesh is one of the seven hottest emerging markets in the world owing to its relatively stable currency with solid foreign reserves and record foreign worker remittances. In 2007, JP Morgan listed Bangladesh next to Vietnam, Nigeria, Kazakhstan, and Kenya as a Frontier Five country with impressive economic and investment potential.

According to the International Financial Corporation (IFC) definition, stock markets in countries with low and middle income per capita are considered to be emerging. With an open market to foreign investors, stock markets of Bangladesh satisfies the definition of an emerging market in terms of income and market capitalization to Gross National Income ratio. While in 2000 the market capitalization was only around 2.24% of the country’s GDP, at the end of June 2012 it stood around 31.64%. The average daily turnover of DSE was stood to Tk. 492.21 crore in 2012, which was only Tk. 10 to 15 crore in 1976 (SEC, 2012-13). When the trading activities restarted in 1976, DSE had only 9 listed companies with a paid up capital of Tk. 137.52 million. The number of listed companies has increased to 515 with a paid up capital of Tk. 24,03,555.62 million at the end of 2012. An economy with well-functioning stock markets should experience a higher growth rate of output. According to a broader range of indicators, Bangladesh has performed well, especially on or after 1990s (Ministry of Planning, GoB, 2011). Major economic indicators have generally favorable for Bangladesh. Table 2.1 summarizes key economic and financial indicators for Bangladesh, where GDP, export, import, narrow money and broad money are stated in billion Taka, whilst GDP in current market price, GDP growth rate as percent in fixed price, per capita GDP in current price (US\$). Manufacturing % share to GDP are stated at constant price, while

total consumption as % of GDP, total investments as % of GDP and national savings as % of GDP are stated at current market price. Government revenue and government expenditure are expressed as % of GDP. Foreign exchange reserves are stated in crore US Dollar, while inflation rate is measured by CPI base:1995/96 and DGEN is the general price index of DSE. Table 2.1 shows that the rate of economic growth is increased from an average rate of 4.42% in the FY 2002 to 6.23% in the FY 2012. Export is increased from Tk. 343.7 billion to Tk. 2116.43 billion, and foreign exchange reserves are increased about 10 times from FY 2002 to FY 2012.

**Table 2.1: Economic and Financial Indicators of Bangladesh**

	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13*
<b>GDP</b>	2732	3006	3330	3707	4157	4725	5458	6148	6943	7967	9181	10380
<b>GDP Growth</b>	4.42	5.26	6.27	5.96	6.63	6.43	6.19	5.74	6.07	6.71	6.23	6.1
<b>Per Capita GDP</b>	361	389	421	441	447	487	559	620	687	748	766	845
<b>Manufacturing share to GDP</b>	15.2	15.4	15.5	15.8	16.4	17	17.1	17.3	17.3	17.8	18.3	18.9
<b>Total Consumption</b>	81.8	81.8	80.7	80	79.8	79.7	79.7	79.9	79.9	80.7	80.7	80.8
<b>Total Investments</b>	23.2	23.4	24	24.5	24.7	24.5	24.2	24.4	24.4	25.2	26.5	26.8
<b>National Savings</b>	22.4	24.5	25.4	25.8	27.7	28.7	30.2	29.6	30	28.8	29.2	29.5
<b>Goods Export</b>	344	379	448	532	698	963	971	1072	1123	1608	1898	2116
<b>Goods Import</b>	491	559	643	809	892	1345	1337	1396	1480	2159	2530	2724
<b>Govt. Revenue</b>	10.2	10.4	10.6	10.6	10.8	10.6	11.3	11.3	11.5	10.2	12.6	13.5
<b>Govt. Expenditure</b>	14.9	14	14.2	14.5	14.2	14.3	17.5	15.3	16	16.5	17.6	18.2
<b>Narrow Money</b>	242	267	305	356	427	502	593	664	880	1031	1097	1236
<b>Broad Money</b>	986	1140	1297	1515	1807	2115	2488	2965	3630	4405	5171	6035
<b>Foreign Ex.Reserves</b>	158	247	271	293	348	508	615	747	1075	1091	1036	1532
<b>Deposit Rate of Interest</b>	6.74	6.29	5.65	5.62	6.68	6.85	6.95	7.01	6.01	7.27	8.15	8.54
<b>Bank Rate</b>	6	6	5	5	5	5	5	5	5	5	5	5
<b>Exchange Rate (Tk./\$)</b>	57.9	57.9	60.4	63.8	69.7	68.8	68.5	69	69.5	74.2	81.8	77.8
<b>Inflation Rate</b>	3.58	5.03	5.64	7.35	7.54	9.20	10	2.25	8.7	10.2	8.56	7.97
<b>DGEN Index</b>	793	831	1319	1713	1340	2149	3001	3010	6154	6117	4573	4386

Note: \* National accounts figure and financing figures of 2012-13 are provisional and as per revised budget respectively.

Source: Bangladesh Economic Review, 2013 issued by Ministry of Finance, and Monthly Economic Trends, February 2014 issued by Bangladesh Bank.

This brief presentation of statistical data on Bangladesh's economic performance thus establishes that Bangladesh is now an example of a country that manages to overcome frequent natural disasters, and difficult social and political situations to improve the quality of life of its people. This makes it an example to other developing economies in the world, although a long way to go to prove the projections to become one of the fastest growing economy. So, Bangladesh, once known as the bottomless basket in 1970s, is now an emerging economy despite of its confrontational politics over the past few decades.

### **2.3 Financial System of Bangladesh**

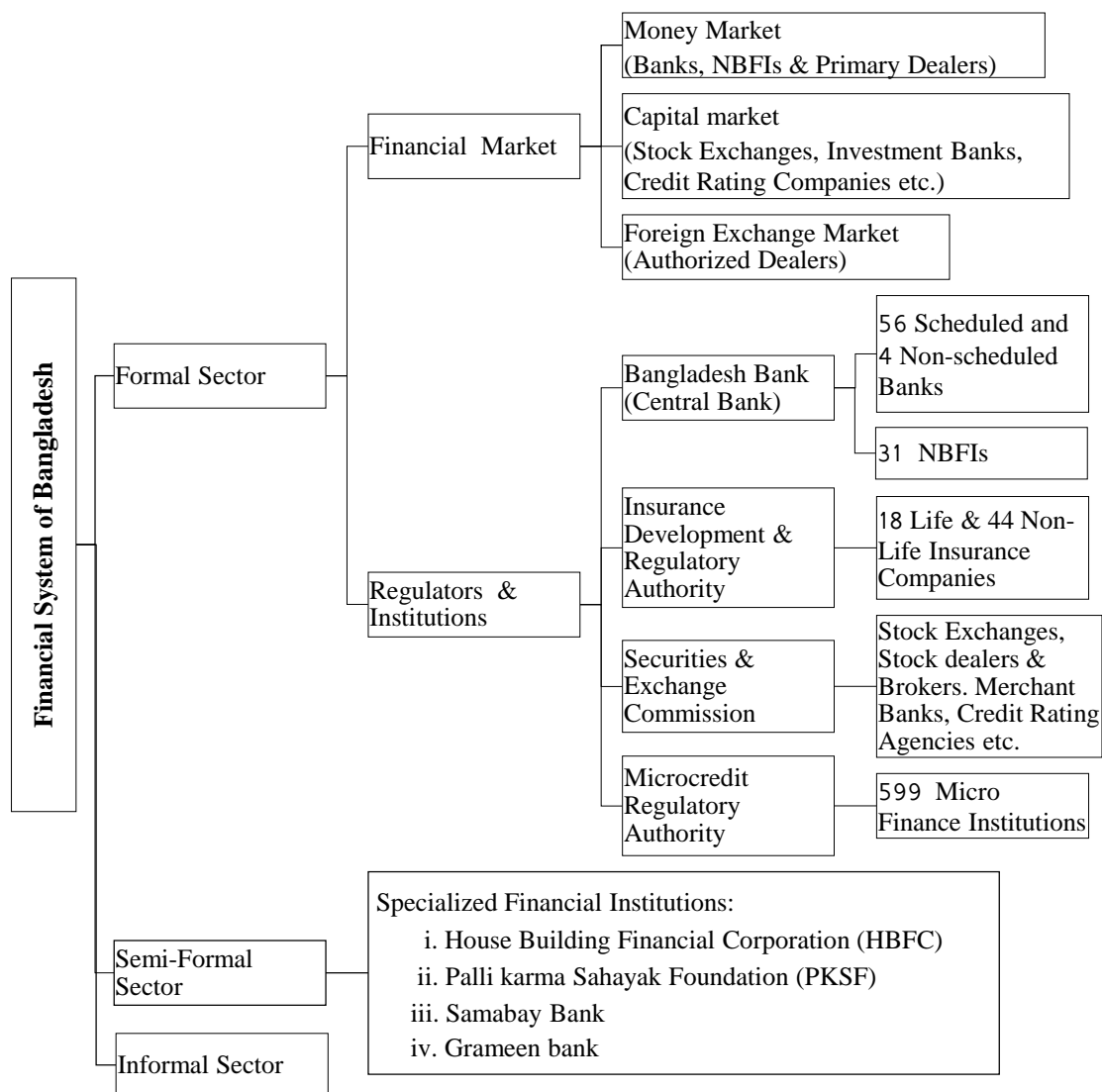
The Financial System is a set of institutional arrangement through which surplus units transfer their fund to deficit units. The financial system of Bangladesh consists of three broad fragmented sectors:

- i. **Formal Sector:** The formal sector includes all regulated institutions like Banks, Non-Bank Financial Institutions (FBFIs), Insurance Companies, Capital Market Intermediaries like Brokerage Houses, Merchant Banks and Micro Finance Institutions (MFIs).
- ii. **Semi-Formal Sector:** The semi-formal sector includes those institutions which are regulated otherwise, but do not fall under the jurisdiction of Central Bank, Insurance Authority, Securities and Exchange Commission or any other enacted financial regulator. This sector is mainly represented by Specialized Financial Institutions like House Building Finance Corporation (HBFC), Palli Karma Sahayak Foundation (PKSF), Samabay Bank, Grameen Bank, and Non-Governmental Organizations (NGOs and discrete government programs).
- iii. **Informal Sector:** The informal sector includes private intermediaries which are completely unregulated.

The financial system of Bangladesh is mainly dominated by formal sector and the main constituent of the financial system is the financial market. Figure 2.1 gives an overview of broad segments of the financing sector in Bangladesh. It is inherited a narrow and thin financial sector with six commercial banks which have nationalized under the

nationalization order of 1972, few foreign banks and two government owned specialized financial institutions.

**Figure 2.1: Financial System of Bangladesh**



Source: [www.bb.org.bd](http://www.bb.org.bd)

The banking system operated until the end of 1980s with the directives of monetary authorities aiming at achieving objectives of supplying cheap money to the State Owned Enterprises (SEOs) and priority sector like Agriculture, Export and Small and Cottage Industries. Although, commercial bank branches have expanded promptly and even in the rural areas during this time, but many branches suffered substantial losses due to corruption and mismanagement. The persistent vulnerability in the money

market also observed in the capital market. The only stock exchange of the country, namely the Dhaka Stock Exchange remained almost out of action with only a few enlisted companies. Bangladesh Shilpa Bank (BSB) & Bangladesh Shilpa Rin Shangastha (BSRS) supported projects out of loans from IDA, ADB etc. Cumulative effect of maladministration in money and capital market guided to a state of mess in the financial sector, though a National Commission of Money, Banking and Credit has constituted in 1984. But, the real changes and reforms in the financial sector of Bangladesh have started through the Financial Sector Reforms Project (FSRP) that has launched in 1990 under Financial Sector Adjustment Credit. Some of the reform measures that have taken place are stated below in brief:

#### **a) Institutional Reforms**

- Privatization of Banks
- Liberalization of Interest Rate
- Creation of Credit Information Bureau (CIB)
- Securities and Exchange Commission (SEC) has established on June 8, 1993 under the Securities and Exchange Commission Act, 1993
- Chittagong Stock Exchange has established in 1995
- New Loan Classification Guideline
- Capital Adequacy Requirement
- On-site and Off-site Supervision

#### **b) Legal Reforms**

- Bank Companies Ordinance, 1962 has replaced by Bank Companies Act, 1991
- The Financial Institutions Act, 1993 has originated to deal with NBFIs
- Bangladesh currency, the Taka, has declared convertible on current account transactions (as on 24 March 1994), in terms of Article VIII of IMF Article of Agreement (1994)
- Merchant Banker & Portfolio Manager Rules has formed in 1996
- Credit Rating Companies Rules has designed in 1996
- The Bankruptcy Act has passed in 1997

- Central Depository Bangladesh Ltd (CDBL) has formed in 2000 which conducts its operations under Depositories Act 1999, Depositories Regulations 2000, Depository (User) Regulations 2003, and the CDBL by-laws
- Mutual Fund Rule has formulated in 2001
- Bangladesh has adopted Floating Exchange Rate regime since 31 May 2003
- Microcredit Regulatory Authority Act has formulated in 2006
- SEC has updated Public Issue Rules, 2006 and Mutual Fund Rules, 2001
- Insurance Act has formulated in 2010.

We have observed a lot of reforms in the financial sector during the last few years. But an impartial observation brings to light that the pace of adapts to reforms has remained much sluggish than anticipated. Bangladesh is one of the luckiest countries where people are not actually felt the effect of recent world recession. Keeping this fact in mind, the overall scenario of the financial sector is still not very much good to be satisfied. The primary money market of Bangladesh consists of banks, financial intermediaries (FIs), primary dealers as intermediaries, and savings and lending instruments, treasury bills as instruments. There are currently 15 primary dealers (12 banks and 3 FIs) in Bangladesh. The only active secondary market is an overnight call money market, which is participated by the scheduled banks and FIs. The common types of money market securities traded in Bangladesh are Treasury Bills (T-Bills), Repurchase Agreements (Repo or Reverse Repo), Commercial Papers (the bills of exchange and promissory notes, mutual funds etc.), Certificate of Deposit, and Bankers' Acceptance. Treasury Bills are available in the primary market as well as in the secondary market. The capital market of Bangladesh is small as the non-securities segment of the total financial system gain control of more than ninety % of the financial activity. The capital market is composed of both the primary and secondary markets. Both the stock and bond markets are part of the capital market. The Bangladesh Capital Market turns out to be a gradually worthy component of the Bangladesh financial system. It opens door for public and private companies to raise enormous amounts of capital from a lot of individual and organizational investors inside and outside of the country. Bangladesh capital market products are shares, debentures, mutual funds and bonds. Market players are Bangladesh Securities and Exchange

Commission (BSEC), Stock Exchanges (DSE and CSE), Private Limited Companies, Brokers and Dealers, Merchant Banks, Asset Management Companies (AMCs), Investment Corporation of Bangladesh (ICB), Credit Rating Companies (CRCs), Investors, and Central Depository Bangladesh Limited (CDBL).

Financial sector of Bangladesh, like most developing countries, is dominated by banks who operate under full control and supervision of Bangladesh Bank. Apart from foreign banks, most of the Bangladesh scheduled banks are failing to achieve satisfactory improvement in spite of a series of reform initiatives over the years. The worst scams in the history of the banking sector of Bangladesh have taken place during the last two years, while about Tk. 100 billion are wiped out by the fraud customers with the help of bank directors and officials. Moreover, The amount of non-performing loans of the banking sector has increased from Tk. 201 billion in 2006 to Tk. 513.4 billion in June, 2014. In spite of the scenario, the amount of industrial term loans disbursed by banks and financial institutions has stood at Tk. 423.1 billion, while only Tk. 6.6 billion has been raised by new capital issues through private placements and public offerings in the capital market in FY 2014. This picture indicates that the commercial banking system dominates the financial sector with a limited role of non-bank financial institutions and the capital market.

## **2.4 Historical Development of the Bangladesh Stock Market**

Stock market concepts commenced in Amsterdam in 1602 while the Dutch East India Company introduced easily transferable shares. It moved to England, USA and South Asia in 1773, 1790 and 1890 respectively. The history of the Bangladesh stock market can be sketched back in 1952 when the Calcutta stock exchange had disallowed the transactions in Pakistani shares and securities. Since 1952, the Bangladesh stock market can be classified for this study into two development stages depending on its structure, operations and regulations. The first stage, the initial stage covers the period of time from 1952 to 1990. The second stage, the established and modernized stage begins from 1991. In the following two subsections, the thesis presents some essential aspects of each of the two stages.

#### **2.4.1 Stage 1: Initial Stage (1952-1990)**

In the initial stage, the Bangladesh stock market remained informal and primitive. Three factors hindered the advancement of the stock market during this phase. First, during the pre-liberation war, the Pakistan government given a negligible effort to develop an economic foundation of East Pakistan and the discriminating policy continued to the stock market of East Pakistan. Second, during the period of 1971 to 1975, the first government of sovereign Bangladesh taken up a commanding economic policy and suspended the stock market. Third, during the period of 1976 to 1990, the militant governments did not provide importance for the development of stock markets.

The people of Bangladesh (East Pakistan) revealed their identity through the historical Language Movement in 1952. The success of the Language Movement in 1952 stimulated to the economy of East Pakistan as an organizing committee consisting of leading commercial and industrial personalities of East Pakistan was appointed by the provincial industrial advisory council in order to formation of a stock exchange in East Pakistan. The central government proposed to open a branch of Karachi Stock Exchange in Dhaka. But the members of the organizing committee in their second meeting that held on the 13 March 1953 decided that East Pakistan should have an independent stock exchange. Following a series of successful meetings, the desired stock exchange officially has formed on 28 April 1954 as a public company under the companies act 1913, and named the 'East Pakistan Stock Exchange Association Ltd.'. The name of East Pakistan Stock Exchange Association Ltd. changed to East Pakistan Stock Exchange Ltd. on 23 June 1962. Again on 14 May 1964 the name revised to 'Dhaka Stock Exchange Ltd.' At the time of incorporation the authorized capital of the exchange was RS. 300000 divided into one hundred fifty stocks of RS. 2000 each. Even though integrated in 1954, the formal buying and selling of securities used to be began in 1956 in Narayanganj after obtaining the certificates of commencement of business. It has shifted to Dhaka and began functioning in the Narayanganj Chamber building in Motijheel C/A in 1958. The stock exchange has purchased a land at 9F Motijheel C/A of Dhaka from the government and then again shifted to its own building from on 1 October 1957. The Dhaka Stock Exchange (DSE) received its legislative assistance from the Securities and Exchange Ordinance undertaken in 1969 during the Pakistan rule.



The major functions decorated by DSE are on its website being the followings:

- Listing of Companies (As per Listing Regulations)
- Providing the screen based automated trading of listed Securities
- Settlement of trading (As per Settlement of Transaction Regulations)
- Gifting of share / granting approval to the transaction/transfer of share outside the trading system of the exchange (As per Listing Regulations 42)
- Market Administration & Control
- Market Surveillance
- Publication of Monthly Review
- Monitoring the activities of listed companies (As per Listing Regulations)
- Investors' grievance Cell (Disposal of complaint by laws 1997)
- Investors Protection Fund (As per investor protection fund Regulations 1999)
- Announcement of Price sensitive or other information about listed companies through online.

Prior to the independence of Bangladesh, there were 196 securities listed on the DSE with a total paid-up capital of about Taka 4 billion (Chowdhury 1994). Ever since the birth of Pakistan in August 1947, the people of Bangladesh frequently discovered themselves deprived and exploited by the power elite dominated by the West Pakistani bureaucrats and army. As a result, the Liberation war was started on 26 March 1971 supported by the heroic resistance and supreme sacrifices of the valiant freedom fighters, and in conclusion Bangladesh has turned into an independent sovereign state on 16 December 1971. Trading activity of the DSE suspended for the start of the liberation war until it restarted in 1976. The stock market development in Bangladesh suffered most from political indecision regarding its strategic importance for the economy especially for the initial stage. When restarted in 1976, DSE was only 9 listed companies with a paid-up capital approximately Tk. 137.52 million and at the end of that year total market capitalization of listed securities was about Tk. 146.73 million.

In 1977, the Investment Corporation of Bangladesh (ICB) has been established in order to give institutional support to the stock exchange. In 1979, the first ICB unit fund has been introduced to the market. The issues of developing a corporate bond market has remained non-existent in Bangladesh. Bond Market in Bangladesh in the initial stage

has entirely dominated by Bangladesh Bank. Wage Earners Development Bonds have been issued in 1981 to be sold to Bangladesh wage earners abroad. Later, a two-year special treasury bond has been issued in January 1984 to be sold to individuals, public, and private sector organizations including banks. In December 1985, the National Bond has been issued to be sold to non-bank investors. Interest-free Treasury bond has been issued in 1988 and withdrawn in 1993. The debentures has been approached to the market in 1988 and 1989, while Beximco pharma and Beximco limited issued two corporate debt securities in Bangladesh. Bangladesh has suffered by political turmoil and military rules in most of the times up to 1990. Bangladesh has remained very poor considering all counts of the capital market expansion criterion under the initial stage. It is going to be very transparent after observing the examples used by Chaudhury and Miyan (1990). They mention that the economies of Taiwan, Korea, India and Malaysia are roughly 2.4, 5.1, 14 and 1.96 times than the economy of Bangladesh; however, their stock market capitalization are about 272, 184, 133 and 104 times that of Bangladesh. The total scenario of the stock market in the initial stage has continued unpleasant. By 1990, the number of listed companies, market capitalization and turnover in DSE have increased up to 134, Tk. 11.49 billion and Tk. 0.19 billion respectively.

Though the financial sector reform process in Bangladesh has started since the early 1980s with privatization of banks, but any major changes regarding capital market have not taken place. Thus, we can say that the development of capital market in Bangladesh in the initial stage has suffered most from political indecision regarding its strategic importance for the economy of Bangladesh.

#### **2.4.2 Stage 2: Established and Modernized Stage (1991-Present)**

Financial liberalization is widely considered to lead to more rapid economic growth. Kim and Kenny (2007) find that equity markets are opened earlier in countries that trade more with developed countries and that have more developed financial markets. They also comment that equity markets are opened earlier in democracies, especially if the country's leader is a civilian. Bekaert et al. (2003) denote that most developing countries liberalized their stock market during the late 1980s and early 1990s. They have given rights of entry to their stock market in an effort to attract foreign investment. In order to overcome the weakness associated with the initial stage, the restored

democratic government of Bangladesh has adopted a free market economy and raised assistance to the stock market for rapid economic and financial development. The financial sector reforms in Bangladesh have begun during the first half of the 1990s include liberalization of interest rates, improvement of monetary policy, strengthening central bank supervision, regulating banks, improving debt recovery, and broadening capital market development. The Financial Sector Reforms Project (FSRP) launched in 1990 in Bangladesh under Financial Sector Adjustment Credit (FSAC) of International Development Association (IDA) of the World Bank. Bangladesh has officially relaxed her restrictions on investment initially for non-resident Bangladeshis in May 1991 and later for foreign investors. Now Bangladesh is considered 100% free in general for foreign investment in listed stocks while some restrictions in place for defense, nuclear energy, security printing, railways, air transportation, and forest plantation (Standard and Poor's, 2009).

In terms of the regulatory structure, more than two decades later, the capital market of Bangladesh has received its second legal backing in 8 June 1993 as the 'Securities and Exchange Commission' has established under the Securities and Exchange Act 1993 with the following mission (SEC Annual Report, 2011-12). Through an amendment of the Securities and Exchange Act 1993, the name of the Securities and Exchange Commission has been changed as 'Bangladesh Securities and Exchange Commission' on December 10, 2012.

The mission of the BSEC is to:

- Protect the interests of securities investors
- Develop and maintain fair, transparent and efficient securities markets
- Ensure proper issuance of securities and compliance with securities laws.

Chittagong Stock Exchange (CSE) is the second stock exchange and a big wing of the Bangladesh capital market. It has incorporated as a non-profit organization on 1 April 1995 and formally opened on 10 October 1995. As on 30 June 2013, there are 266 securities listed in CSE with a market capitalization of Tk. 2,613,382 million. The CSE outlines the major objectives on its website being the followings:

- Increase business turnover
- Modernize trading system
- Ensure effective relationship management
- Achieve high level of confidence & professionalism
- Engage in product and market diversification
- Contribute to capital market policy development
- Ensure exchange related quality services.

In the race of the establishment, the stock markets of Bangladesh slept twice in 1996 and 2010-11. The stock markets shown off a route of easy money for too many new individual investors. Manipulators took the opportunity of unawareness of individual investors and earned a lot of money, while general investors got huge loss. Manipulation concerning paper shares, lack of monitoring about unusual market movement, increased investor participation, and demand for stocks done the damage in the stock market of Bangladesh in 1996 and 2010-11. The SEC formed a probe committee in both cases, but it did not yield anything regarding manipulators punishment apart from a lot of regulatory reforms.

In the beginning, DSE and CSE remained as physical stock exchange. CSE has started its automated trading on 2 June 1998 and internet trading service on 30 May 2004 in order to secure, smooth, timely and effective operation of trading while DSE has started its automated trading system from on 10 August 1998 and upgraded time to time. One of the principal milestones achieved in the history of Bangladesh capital market on 20 August 2000 as the Central Depository Bangladesh Limited (CDBL) has incorporated as a public limited company in order to attract more investors especially foreigners. The Central Depository System (CDS) facilitates electronic book entry, recording and maintaining securities accounts, and transfer of securities. As of June 2013, the depository participants has increased to 363 in the CDBL. The Dhaka Stock Exchange (DSE) has 195 SEC registered trading members/brokers and the Chittagong Stock Exchange (CSE) has 124 registered brokers. Investors execute their deal through a registered broker of a recognized stock exchange or through a registered authorized representative. DSE provides Over-The-Counter (OTC) facilities for transaction of share of companies which is followed by Securities and Exchange Commission (Over-the-Counter) Rules, 2001. DSE-OTC has started its journey on October 01, 2009 with

51 companies. Total number of securities has stood at 66 under OTC facility as on 14th May, 2014.

**Table 2.2: Milestones achieved by Stock Markets of Bangladesh from 1954 to 2014**

<b>Milestones</b>	<b>Date</b>
DSE (East Pakistan Stock Exchange Association Ltd) Incorporated	28 April 1954
Start of Formal Trading	1956
Renamed as East Pakistan Stock Exchange Ltd.	23 June 1962
Renamed as Dacca Stock Exchange Ltd.	13 May 1964
Trading Suspended During the Liberation War	1971
Trading Suspended under new State Policy	16 December 1971
Trading Resumed in Bangladesh	16 August 1976
Starting of All Share price Index (DSI) Calculation	16 September 1986
Market Liberalization	May 1991
Regulatory Authority SEC Established	08 June 1993
DSI Calculation on Basis of IFC Designed Formula	1 November 1993
CSE Incorporated as a Limited Company	1 April 1995
CSE Introduced Automated Trading on WAN	2 June 1998
DSE Started Online Trading (LAN)	10 August 1998
Starting of DSE-20 Index Calculation	01 January 2001
Starting of DSE General Index (DGEN) Calculation	27 November 2001
Starting of CDS through CDBL	24 January 2004
Internet Trading Service launched (ITS) by CSE	30 May 2004
CSE Introduced Over-the-Counter (OTC) market	4 July 2004
DSE Started Govt. Bond Trading	01 January 2005
DSE Started Online Trading (WAN)	21 August 2005
Regulations of Direct Listing 2006 Introduced	12 April 2006
Amendment of Merchant Bank and Portfolio Manager Rules, 2006	20 April 2009
Amendment of Credit Rating Companies Rules 1996	17 November 2009
Amendment to SEC (Public Issue) Rules, 2006	5 October 2011
Amendment to SEC (Rights Issue) Rules, 2006	2 November 2011
CSE Introduced Next Generation Trading System (NGTS)	20 October, 2011
Amendment to SEC (Issue of Capital) Rules, 2001	12 March 2012
Amendment to SEC (Stock-dealer, Stock-broker and Authorized Representative) Rules, 2000	12 March 2012
SEC Private Placement of Debt Securities Rules, 2012	21 October 2012
Securities and Exchange (Amendment) Act, 2012	10 December 2012
Amendment to SEC (Mutual Fund) Rules, 2001	08 January 2013
DSE Broad Index (DSEX) & DSE 30 Index (by S&P)	28 January 2013
CSE Became Affiliate Member of World Federation of Exchanges	28 October, 2013
DSE & CSE Transformed into a Demutualized Exchange	21 November 2013
DSE Inaugurated Next Generation Automated Trading System	11 December 2014

Source: www.sec.gov.bd, www.dsebd.org and www.cse.com.bd

Some of the milestones in the history of the Bangladesh stock market are stated using the Table 2.2. A decent number of world stock exchanges have remained non-profit organizations with monopoly power owned by their members. But the situation is changing by the concept of the demutualization of stock exchanges which is a recent new phenomenon in the economic world with a history of more or less 20 years. DSE has become profit-oriented companies from nonprofit organizations as on November 2013 as the Demutualization Act 2013 passed by the parliament of Bangladesh on April 29. DSE has become the 23<sup>rd</sup> demutualized exchange in the world, while Bombay took five years to implement the demutualization and Lahore did not implement it in the last seven years.

**Table 2.3: DSE Main Board as on December 2014**

<b>Listed Securities</b>		
Total Number of Listed Securities		546
Total Number of Companies		274
Total Number of Mutual Funds		40
Total Number of Debentures		8
Total Number of Treasury Bonds		221
Total Number of Corporate Bonds		3
<b>Total Number of Shares/Certificates</b>		(No. in million)
Total Number of Shares & Mutual Fund (includes Bonus /Right of shares )		49,234
Total Number of Shares of All Listed Companies		44,917
Total Number of Certificates of All Listed Mutual Funds		4,304
<b>Total Number of Bonds</b>		(No. in ' 000)
Total Number of All Listed Debentures		409
Total Number of All Listed Government Treasury Bonds		5,485
Total Number of All Listed Corporate Bonds		6,267
<b>Total Issued Capital</b>	(Tk.in million)	(US\$ in million)
All Listed Securities	1,054,926	13,547.28
All Companies Shares	456,094	5,857
All Mutual Funds	43,044	553
All Debentures	140	2
All Listed Govt. T-Bonds	549,381	7,055
All Listed Corporate Bonds	6,267	80
<b>Total Market Capitalization</b>	(Tk.in million)	(US\$ in million)
All Listed Securities	3,244,406	41,664
All Listed Companies Shares	2,657,773	34,131
All Listed Mutual Funds	30,334	390
All Debentures	576	7
All Listed Govt. T-Bonds	549,381	7,055
All Listed Corporate Bonds	6,342	81
* Conversion Rate: Tk. against US\$: 77.87		

Source: www.dsebd.org

The stock markets of Bangladesh have performed well in this stage (1991-Present) compared with the initial stage in spite of two market crashes. Table 2.3 portrays the present scenario of the DSE. The bond market has played a very insignificant role in developing the economy of Bangladesh. After Beximco pharma debenture and Beximco limited debenture, another 12 corporate debentures have issued in Bangladesh between 1992 to 1999, while 08 debentures are available in the market at present. Bangladesh government has issued 5 years and 10 years maturity government bonds under the Bangladesh Government Treasury Bond Rules, 2003. The Treasury and corporate bond have come to the market in 2005 and 2007 respectively. The bonds have been opened for transaction in the secondary market since January 1, 2005. As on December, 2014, there are 546 securities listed in DSE with a market capitalization of \$41,664 million.

## **2.5 Performance of the Dhaka Stock Exchange**

Though perceived by many as small, Bangladesh is an economy of over 16 million people and made a steady growth over the last two decades. The stock market of Bangladesh is still at a developing stage compared to other emerging markets. However, Islam (2011) mentions that DSE is one of the fastest growing market after that of China in 2010. At present, the stock market of Bangladesh is passing through a critical juncture. The market is suffering from lack of product diversity, mass awareness, and international standards of governance. The market is mainly equity securities based. As on 30 December 2014, total 546 securities are enlisted in the DSE in which there are 274 companies, 40 mutual funds, 03 corporate bonds, 221 treasury bonds, and 08 debentures. But the bond market is entirely neglected both by the corporate firms and the investors. So it is important to create an active bond market to increase the depth of the capital market. DSE has expanded their trading network to the good number of district towns, along with divisional towns and that is why Beneficiary Owner (BO) accounts increased about 185% from FY 2007 to 2010. As on 30 June 2013, 26.45 lacs Beneficiary Owner (BO) accounts are opened with CDBL, while 13.85 lacs BO accounts are opened as on 30 June 2007. As a consequence, demand of the stock trading increased significantly while the issue of supply of good companies' securities and awareness of investors remained inadequate. It followed another stock market crash in

2010-11 after 1996 although the scenario is totally different. After both crashes, Bangladesh capital market witnesses a great deal of changes as considerable reforms and structural changes take place. Currently, the market is progressing with a steady pace.

The Dhaka Stock Exchange is very young as its extensive activity started from 1991 though it was formally started its trading in 1956. The stock market of Bangladesh has started taking a healthy shape through the free market policy adopted by the restored democratic government in 1991 as they decided that a long way to go, and there is no scope for financial development except active capital market. This section presents an overview of the performance of Dhaka Stock Exchange from 1991 to 2012. The performance of the DSE is statistically evaluated by two subsections. Subsection 2.5.1 outlines the market activity of DSE, and subsection 2.5.2 presents market size and market liquidity of DSE.

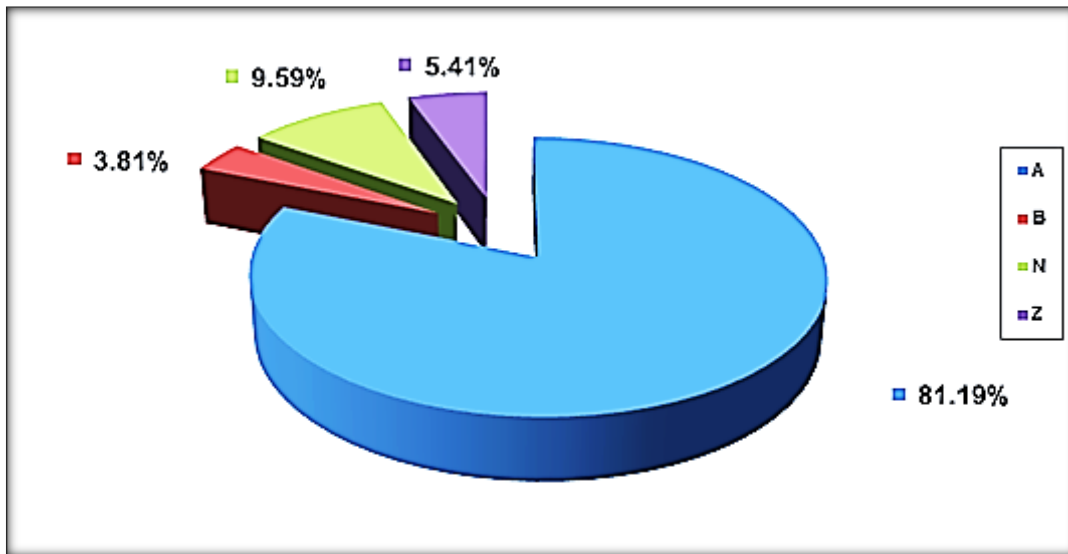
### **2. 5.1 Market Activity of DSE**

The working days of DSE are 5 days in a week without Friday, Saturday, public holidays & other government holidays. The trading time is from 10:30 am to 2:30 pm (local time). Investment options for an investor in this market are Ordinary Share, Debenture, Bond and Mutual Fund. Listed securities (except debentures and treasury bonds) are categorized into ‘A’ ‘B’ ‘G’ ‘N’ and ‘Z’ based on profit-loss, status of the AGM and status of commercial operation.

Figure 2.2 shows the category-wise share turnover of DSE during December 2014. ‘A’ category securities are those which hold AGM regularly and pay 10% or more dividend, ‘B’ category securities are those that hold AGM regularly and pay less than 10% dividend, ‘G’ category are those that have not yet started commercial operation, ‘N’ category are those that newly listed and AGM have not yet take place after the listing and ‘Z’ category securities are those that do not hold AGM regularly or fail to pay any dividend, accumulated loss exceeds the paid up capital or not in operation for more than six months (SEC Annual report 2012-13).



**Figure 2.2: Category-wise Share Turnover during December 2014**

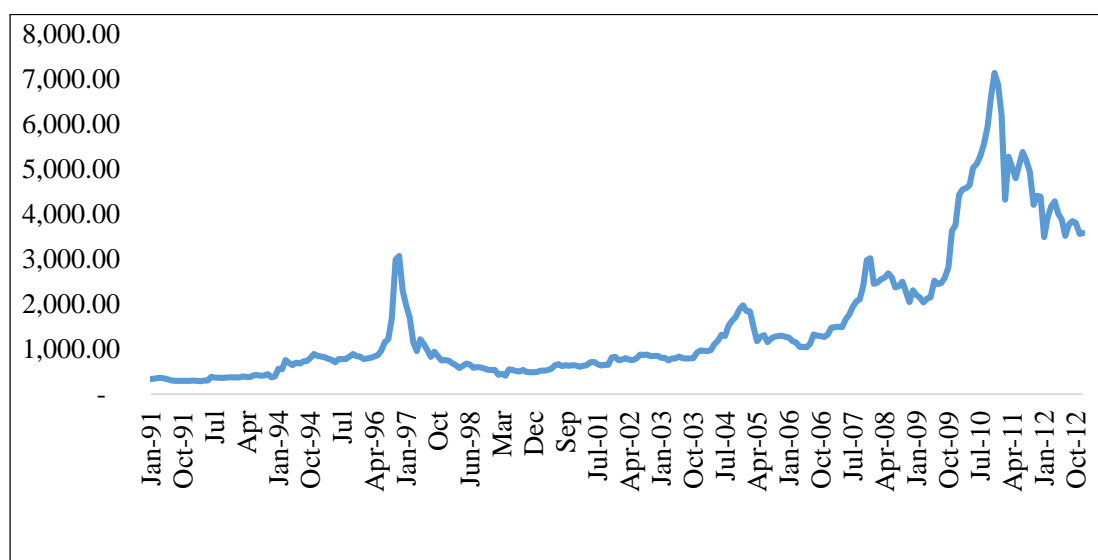


Source: [www.dsebd.org](http://www.dsebd.org)

Before 28 January 2013, DSE used three indices named All Share Index (DSI), General Index (DGEN) and DSE-20 Index where DGEN was treated as a benchmark. DSE used only DSI index until it introduced the DGEN index on November 27, 2001. None of the DSE indices included mutual funds, bonds, and debentures. DSI index formed with all shares price of all categories, while DGEN included all share price except ‘Z’ categories and DSE-20 structured with the 20 best enlisted companies depending on performance and specific criteria. However, on January 28, 2013, DSE has introduced two new indices which are known as the DSE Broad Index (DSEX) and DSE 30 Index (DS30) based on free float and S&P methodology. Now, DSEX is considered as the benchmark index in DSE. Previous studies show that it is possible to have a positive influence on a stock exchange by altering the structure of its indices. Levy and Yagil (2013) investigate the impact of a change in the methodology of constructing a stock index on the stability of a stock exchange. In July 2010, the Tel Aviv Stock Exchange have changed the criteria for the construction of five of its indices. Using data from these five stock indices for the years 2009–2011, they find that the reform increases the quality of all five indices. The liquidity of the indices is increased, the volatility of their returns is decreased, and their mean return is remained unchanged. Thus, two new indices instead of three old indices may help to improve the performance of DSE. Figure 2.3 portrays the volatile month ended DSI

index trend from January 1991 to December 2012. During this period, DSE has faced two major collapses in 1996 and 2010-11.

**Figure 2.3: Month Ended DSI Index from Jan 1991 to Dec 2012**



Source: CD-ROM, DSE Library.

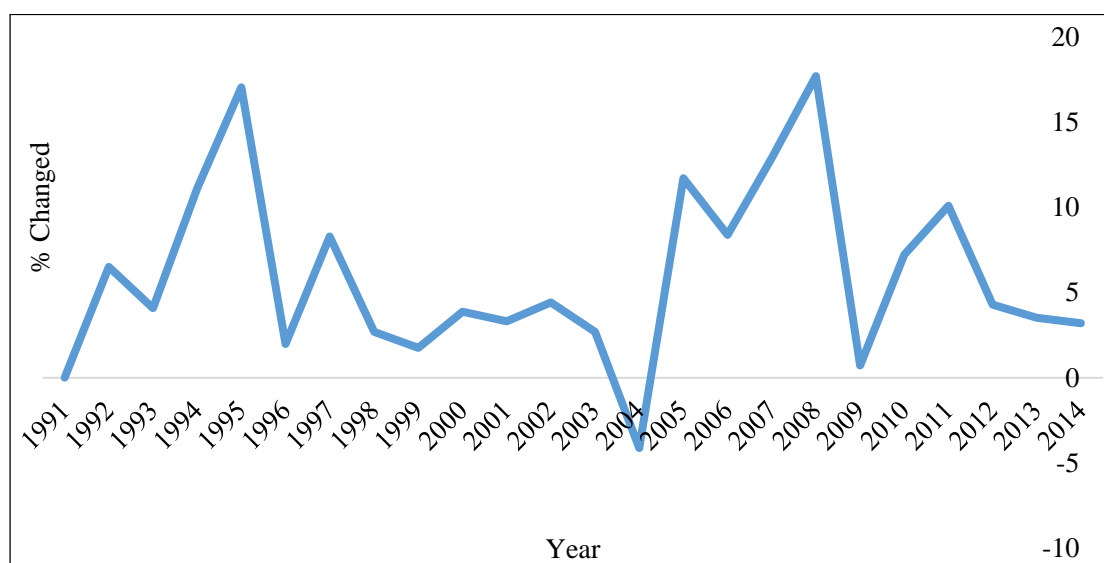
**Table 2.4: Number of Listed Securities in DSE from 1991 to 2014**

Year	Number of Listed Securities	Growth in %	Year	Number of Listed Securities	Growth in %
1991	138	N/A	2003	267	2.69
1992	147	6.52	2004	256	-4.12
1993	153	4.08	2005	286	11.72
1994	170	11.11	2006	310	8.39
1995	201	17.06	2007	350	12.90
1996	205	1.99	2008	412	17.71
1997	222	8.29	2009	415	0.73
1998	228	2.70	2010	445	7.23
1999	232	1.75	2011	490	10.11
2000	241	3.88	2012	511	4.29
2001	249	3.32	2013	529	3.52
2002	260	4.42	2014	546	3.21

Source: Arif (2014) and www.dsebd.org

The trading activities of DSE resumed in 1976 with only 9 companies, and by 30 December 2014, the total number of listed securities is grown to 546. Over the latest 24 years from 1991 to 2014, the number of listed securities is increased to 546 from 138 (Table 2.4). The annual changes of the number of listed securities remained relatively low and stable in all the periods except 1994-95, 1997, 2005-08, and 2010-11 (Figure 2.4). In the 24 years from 1991 to 2014, total number of securities is increased by 6.24% average annual growth rate.

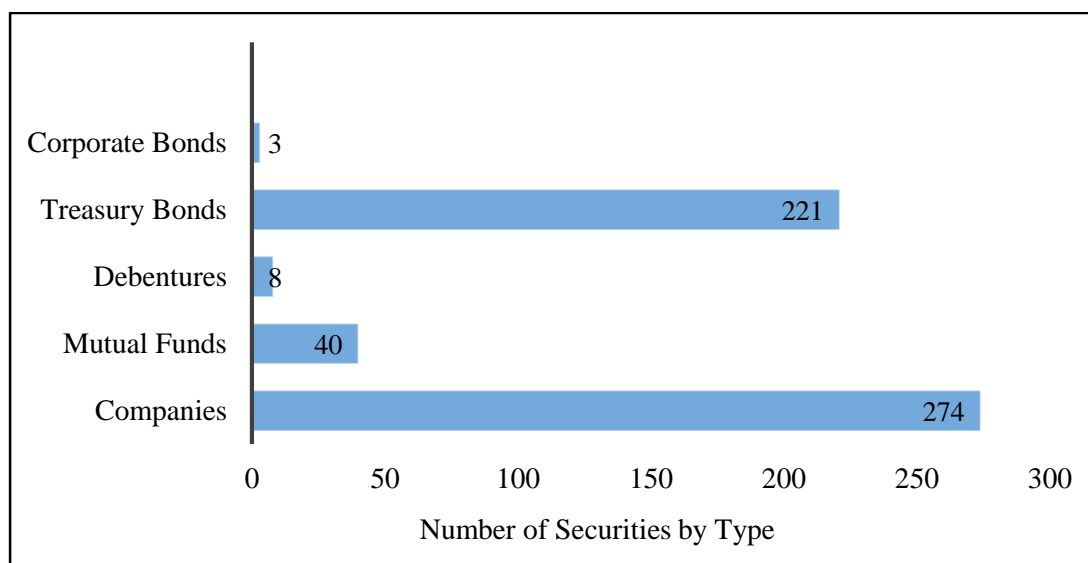
**Figure 2.4: Annual Percentage Changed in Total Number of Listed Securities**



In that 24 years, DSE has added very few companies with an average of about less than 2% annual growth. On the other hand, 221 treasury bonds are enlisted from FY 2005 to FY 2013 and 03 corporate bonds are enlisted from FY 2008 to FY 2012. The number of mutual funds are increased 147% from FY 2009 to FY 2013, while the number of debentures is reduced from 11 to 8 and remained same from FY 2004 to till now.

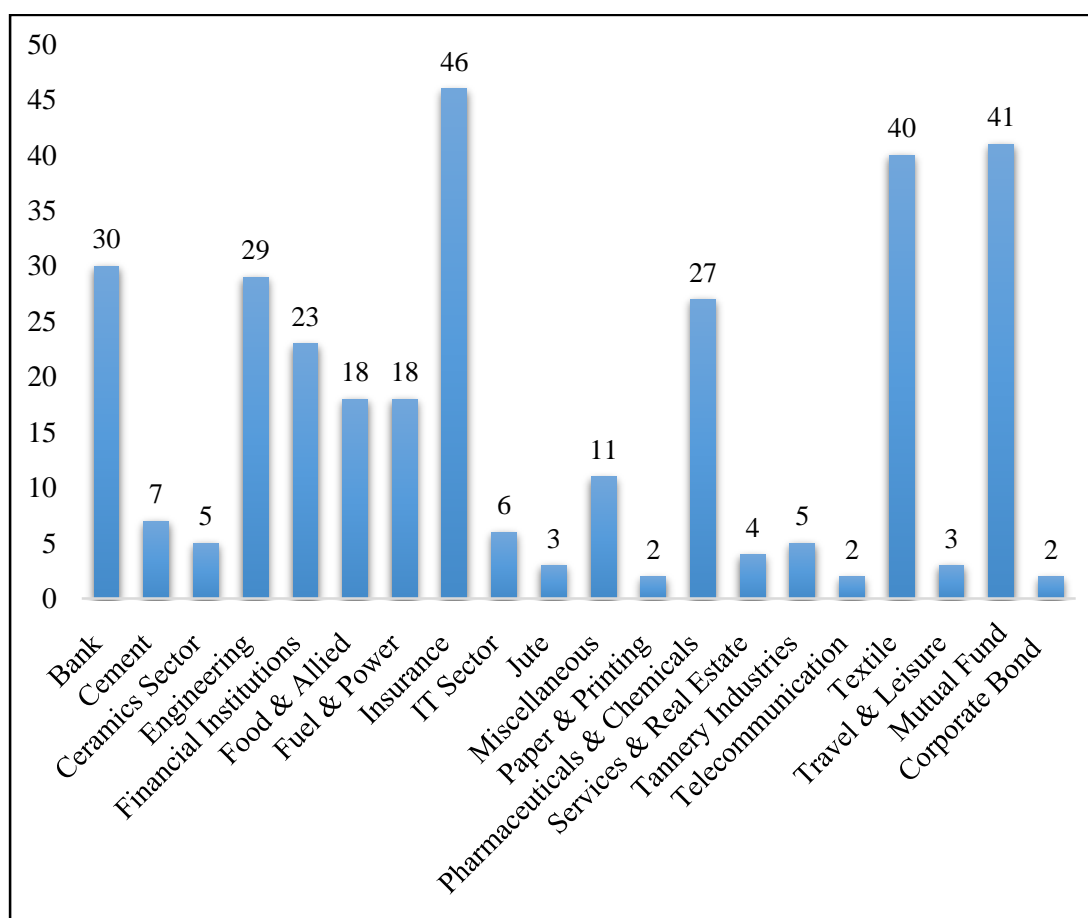
Figure 2.5 shows the types of securities that are enlisted up to December 2014. Despite the fact that the Dhaka Stock Exchange has done well in terms of annual growth of enlisted securities, particularly over the last decade, there is still significant room for improvement. The number of listed securities, especially number of companies and corporate bonds have remained small by international standards. So, the authorities have a large task to do attract new companies to be listed on the market.

**Figure 2.5: Existing Securities by Type as on December 2014**



Source: www.dsebd.org

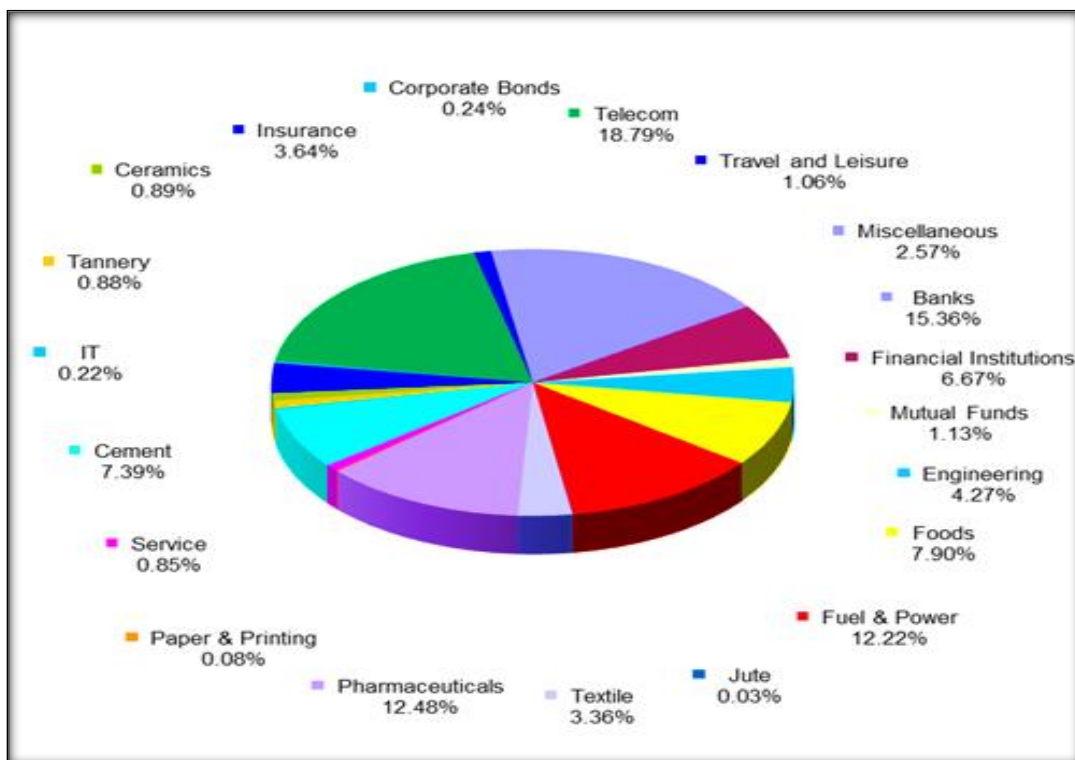
**Figure 2.6: Number of Traded Equities and Bonds by Sub-sector as on 02 April 2015**



Source: www.dsebd.org

DSE has divided the listed securities by several broad sectors named financial, manufacturing, service and miscellaneous, and bond sector. The broad sectors have divided into a lot of subsectors. Financial sector includes equities of banks, financial institutions, insurance, and mutual funds, manufacturing sector comprises shares of foods, pharmaceuticals, textile, engineering, ceramics, tannery, paper and printing, jute and cement, service and miscellaneous sector includes shares of fuel and power, service and real estate, IT, telecommunication, travel, leisure, and miscellaneous companies, and the bond sector includes only corporate bonds. Figure 2.6 portrays a clear picture about the shares of sub-sectors among the 322 traded companies as on 02 April 2015. Insurance, mutual fund, textile, bank, and engineering are the five leading sub-sectors with 46, 41, 40, 30, and 29 companies respectively.

**Figure 2.7: Sectoral Market Capitalization as on December 2014**

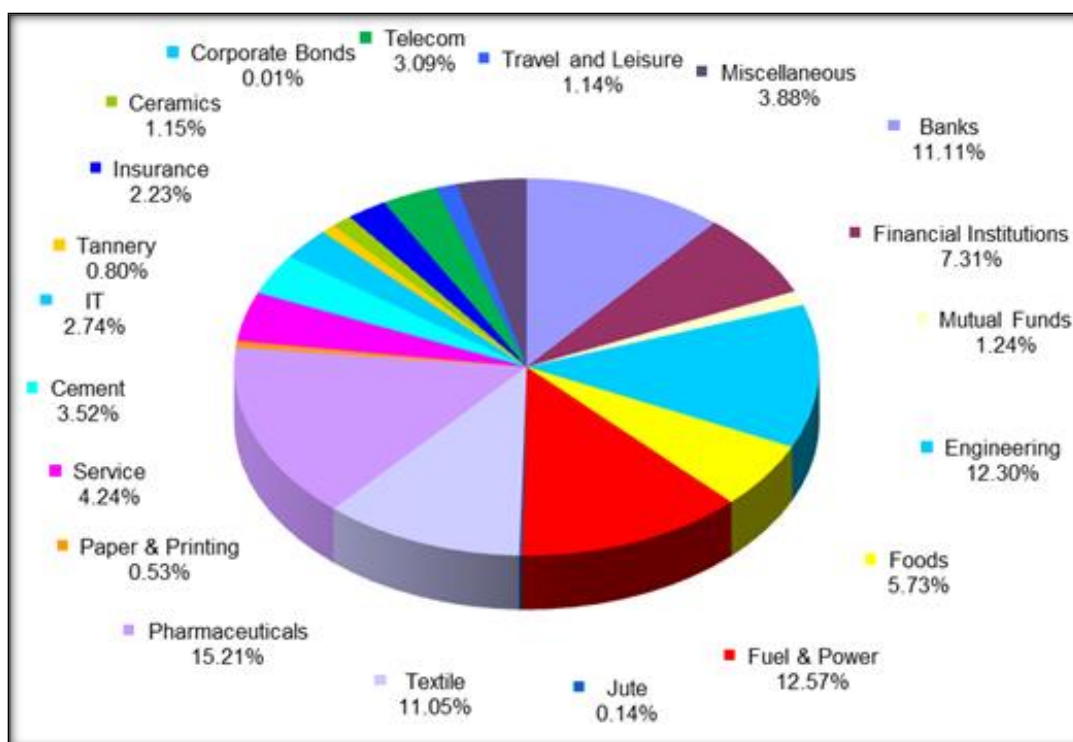


Source: [www.dsebd.org](http://www.dsebd.org)

Figure 2.7 and 2.8 show the percentage of market capitalization and turnover performance of traded equities and bonds by sub-sector as on December 2014. It clearly indicates that DSE has been mainly equity securities based market since bond sectors' market capitalization and turnover are almost nil. So, it is important to create bond

market and making it active to increase the depth of the market. As on December 2014, insurance, mutual fund, textile, bank, and engineering sectors as a whole have acquired about 57% shares of total equities, while market capitalization and turnover of these sectors all together are only 27.76% and 37.93% respectively. Specifically, insurance, mutual fund, textile, bank and engineering sectors have acquired about 14.29%, 12.73%, 12.42%, 9.32% and 9% shares of total equities, while market capitalizations are 3.64%, 1.13%, 3.36%, 15.36% and 4.27% and turnovers are 2.23%, 1.24%, 11.05%, 11.11% and 12.30% respectively. With only two enlisted companies, the market capitalization of telecom sector is a maximum of 18.79% among all sectors in December 2014, while the turnover of telecom sector is only 3.09%. Fuel and power sector have acquired only 5.59% shares of total equities, but this sector is performing well as the market capitalization and turnover of this sector is 12.22% and 12.57% respectively. In terms of turnover as on December 2014, pharmaceuticals sector is placed top with 15.21% turnover, followed by fuel & power, engineering, textile and bank sector.

**Figure 2.8: Sectoral Turnover as on December 2014**



Source: [www.dsebd.org](http://www.dsebd.org)

**Figure 2.9: 1996-97 Market Crash (Day Ended DSI Index)**

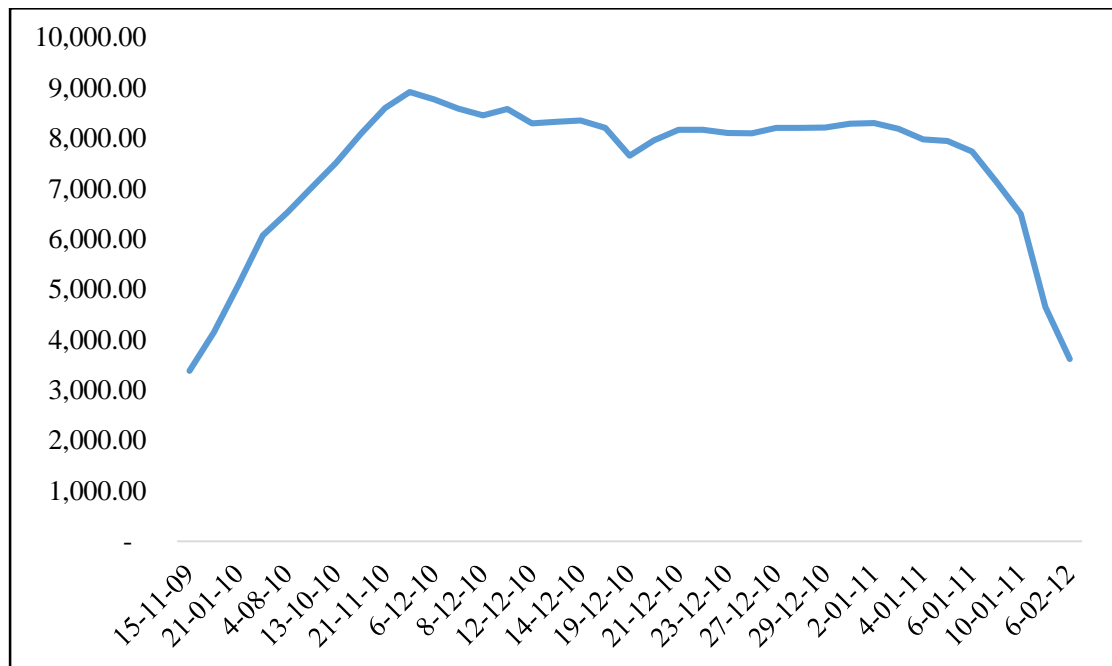


Source: CD-ROM, DSE Library.

During the last few decades, emerging countries along with developed countries have experienced several crises, namely the stock market crash in 1987, the Asian currency crises in July 1997, and the subprime crisis of 2007–2008. These unsettled incidents have quickly multiplied to other emerging economies. During the last two decades, Bangladesh has also experienced two stock market crashes. DSI has started to up turn from 864.87 points in 30 May 1996 and arrived at its peak price of 3648.75 in 05 November 1996. After climbing the highest point it has started to fall sharply and came down 899.38 points on 28 April 1997 (Figure 2.9). During this terrible market crash, all share price index has increased almost 4 times of its points only within 5 months and consequently, the index has lost more than two third of its points within the next 6 months. During the stock market crash of 1996, paper shares used to be sold in front of DSE and it was not easy for investors to identify fake and original share. Thus, chances were taken by the big patron manipulators. Eventually investors have lost everything, especially who invested with a margin loan. The probe committee was formed by the BSEC on 26 December 1996, submitted a report and argued that some foreign portfolio managers, few giant investors, few brokers and sponsors of few listed companies were behind the stock market manipulation in October 1996. In spite of a lot of regulatory reforms and development conducted by the authorities, stock market of Bangladesh

have remained flat over the next decade after the 1996 market crash. Finally, the general index of DSE has crossed 3000 points in December 2007 for the second time in its history. From the third quarter of 2009 the DGEN has expanded dramatically and it has flied to 8918.51 in December 5, 2010 from 3010 points at the end of June 2009 (Figure 2.10).

**Figure 2.10: 2010-11 Market Crash (Day Ended DGEN Index)**



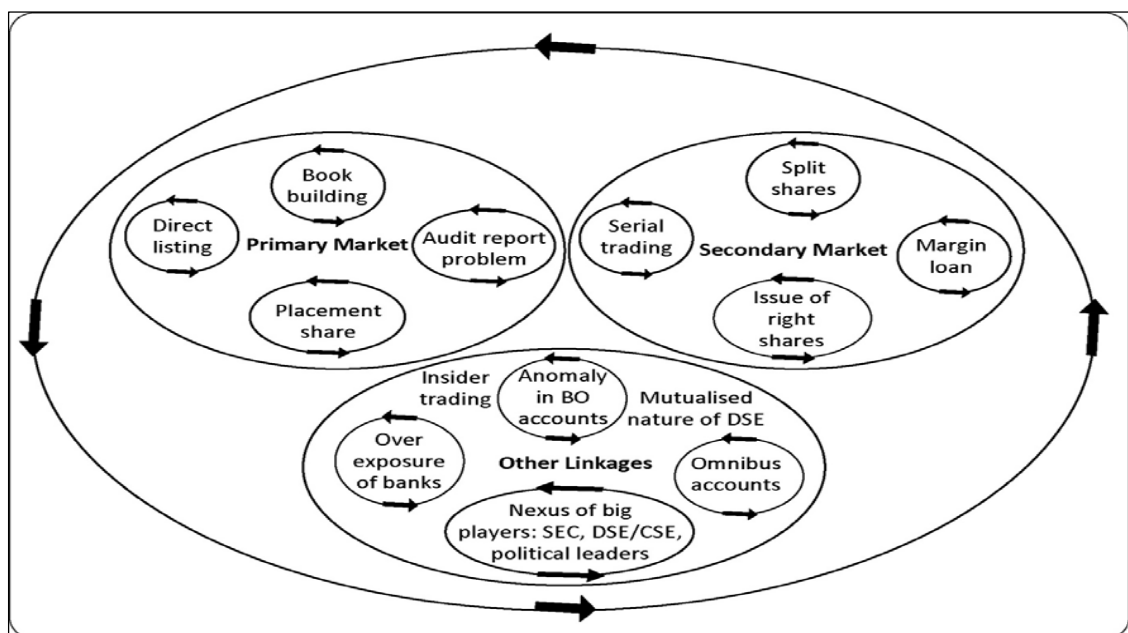
Source: CD-ROM, DSE Library.

The second stock market crash in Bangladesh stricks in between December 2010 and January 2011 mainly due to the indeterminate directives that are directed by Bangladesh Bank and BSEC in December 2010. Directives of 6 and 7 December 2012 are cancelled on 8 December, as in this day, the index drops by a substantial margin. Financial institutions have generally sold shares from the beginning of December to display the highest return on investment of their balance sheet. By this time, after getting a complaint that banks have invested from their reserves into the capital market, Bangladesh Bank investigats it and then circulates a directive that banks must withdraw the illegally invested industrial loan money from the capital market by December 31, 2010. As a result, banks starts to sell shares and withdraw that money from the stock market. Investors continuously lose their nerve as they observe the highest ever turnover in the history of DSE on 5 December 2010. As a result, DSE witnesses its



biggest fall in 55 years history of 551.76 points or 6.71% in 19 December 2010. All of a sudden Bangladesh Bank (BB) also increases Cash Reserve Requirement (CRR) and SLR (Statutory Liquidity Ratio) by 0.5% on 15 December 2010. The next few days, the stock markets of Bangladesh face challenges due to liquidity crisis created by new circular regarding CRR and SLR of Bangladesh Bank. DGEN is declined by 600 and 660 points or 7.75% and 9% in 9 and 10 January 2011 respectively. The DSE index This abnormal and abrupt movement of DSE indexes cause huge losses of investors. As a result, not only investors from Dhaka but also investors from different parts of the country come out in the street with processions. After the stock market crash, Bangladesh government has formed a probe committee headed by the ex-deputy governor of BB named Mr. Khondoker Ibrahim Khaled in 2011. The share market probe committee has presented a report containing of the reasons of the crash and recommendations in 7 April 2011 to the government. In the beginning, it has preserved undisclosed for general people, but, later on it has been disclosed owing to the endless pressure of civil society and investor organizations. A couple of researches like Ullah et al. (2012), Moazzem and Rahman (2012) have acknowledged the reasons behind the crash of the stock market in Bangladesh identical to the probe committee. The major reasons can be presented by the Figure 2.11 that is used by Moazzem and Rahman (2012).

**Figure 2.11: Toxic Elements in the Capital Market of Bangladesh**



Source: Moazzem and Rahman (2012).

Collective efforts of the BSEC, Ministry of Finance and Bangladesh Bank have needed to restore the confidence of investors and bringing stability in the market. The BSEC has conducted some immediate actions like holding 2% shares by directors individually and 30% shares by all directors jointly in the company have been made mandatory except independent directors. The catastrophe has gradually lingered up to the first quarter of 2012 although the authorities have taken several positive steps to restore the pace of DSE. The government has procured a lot of footsteps to tackle the constant diminishing trend of the capital market like tax reduction of capital market investors, exemption of credit for marginal level investors as well as encouragement to the banks to generate more investment in capital market. At present, the stock market of Bangladesh is trying to bounce back.

### **2.5.2 Size and Liquidity of DSE**

This part of the thesis uses up one indicator to measure the size and one indicator to measure the liquidity of the stock market that have been widely used in the literature. The indicators are the ratio of the market capitalization to GDP and the ratio of the value of shares traded (Turnover) to market capitalization, whilst the first indicator is used to measure the size of the stock market and the second indicator is used to measure the liquidity of the stock market. The market capitalization of the share market is the sum of the value of listed shares. Turnover of a stock is computed by multiplying the traded quantity with the price at which the trade takes place. Turnover of the securities listed at the exchange is determined by the value of shares traded in the stock exchange.

Market capitalization to GDP ratio is used to determine whether an overall market is undervalued or overvalued and calculated as:

$$\text{Market Capitalization to GDP} = \frac{\text{Stock Market Capitalization}}{\text{GDP in Current Market Price}} \times 100$$

Typically, a result of greater than 100% provides the indication that the market is overvalued, while a value of around 50% states that the market is undervalued.

Stock market liquidity is a markets' ability to easily buy and sell securities without having to reduce its price very much (Levine and Zervos 1996). Market liquidity is also known as turnover ratio and calculated as:

$$\text{Turnover Ratio} = \frac{\text{Turnover}}{\text{Stock Market Capitalization}} \times 100$$

Table 2.5 displays nominal GDP, total market capitalization and annual total turnover in billion Tk. from 1991 to 2012. It shows the market depth and the turnover ratio, i.e., market liquidity of the DSE from 1991 to 2012.

**Table 2.5: Market Size and Market Liquidity of DSE**

Year	Nominal GDP (in billion Tk.)	Market Capitalization (MC); (in billion Tk.)	Annual Total Turnover (T); (in billion Tk.)	Market Size (Depth) =MC/GDP (%)	Market Liquidity =T/MC (%)
1991	1195.425	10.397	0.12	0.870	1.154
1992	1253.694	12.291	0.44	0.980	3.580
1993	1354.124	18.099	0.58	1.337	3.205
1994	1525.178	41.771	4.29	2.739	10.270
1995	1663.241	56.518	6.38	3.398	11.288
1996	1807.013	168.106	30.133	9.303	17.925
1997	2001.766	71.302	17.403	3.562	24.407
1998	2196.971	50.254	34.368	2.287	68.389
1999	2370.857	44.781	38.964	1.889	87.010
2000	2535.463	62.924	40.365	2.482	64.149
2001	2737.301	65.223	39.868	2.383	61.126
2002	3005.801	71.262	34.985	2.371	49.093
2003	3329.731	97.587	19.152	2.931	19.626
2004	3707.069	224.923	53.181	6.067	23.644
2005	4157.279	233.075	64.835	5.606	27.817
2006	4724.769	323.368	65.069	6.844	20.122
2007	5458.223	753.950	322.820	13.813	42.817
2008	6147.952	1059.530	667.965	17.234	63.044
2009	6943.243	1887.177	1475.301	27.180	78.175
2010	7967.04	3508.006	4009.913	44.031	114.307
2011	9181.414	2853.892	902.483	31.083	31.623
2012	10379.867	2491.613	1171.451	24.004	47.016

Source: Author's calculation and Arif (2014).

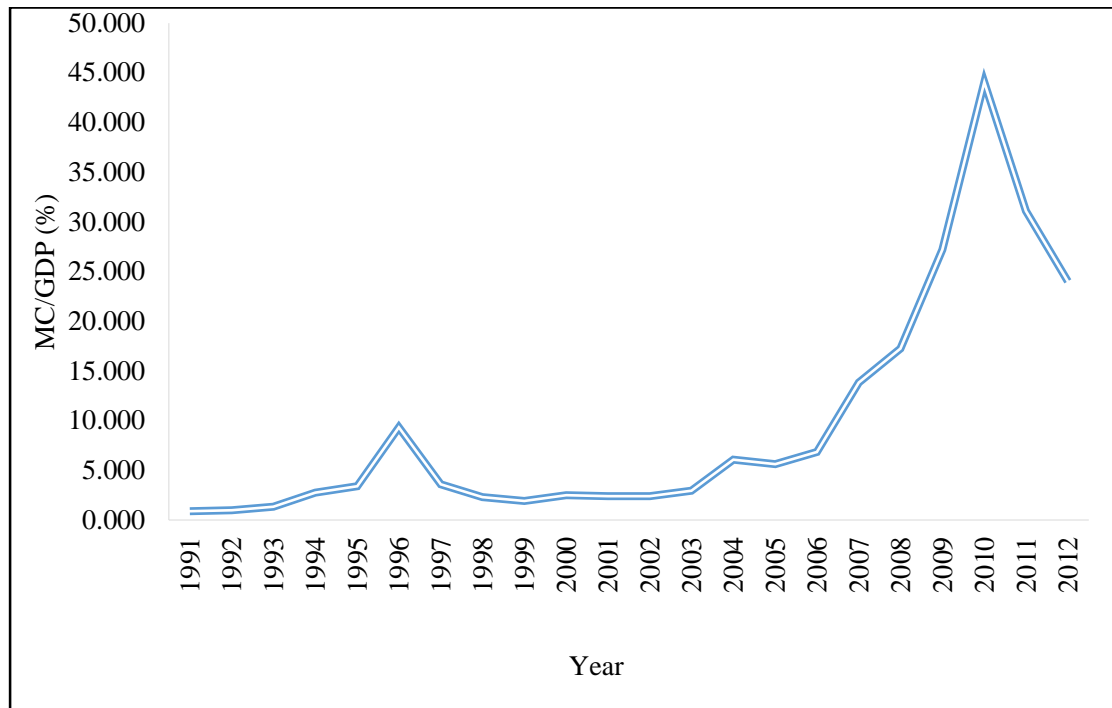
In terms of market capitalization of the securities, DSE has increased about 239 folds between 1991 and 2012, when the capitalized amount reached from Tk.10.397 billion to Tk. 2491.613 billion. Market capitalization of the securities of the DSE has grown 197% from 1995 to 1996 and it has flourished 86% from 2009 to 2010. The GDP at current market prices has increased about 9 folds between 1991 and 2012, when the GDP has arrived at Tk. 10379.867 billion from Tk. 1195.425 billion. In terms of annual total turnover of the securities, DSE has grown about 9762 folds between 1991 and 2012, when the annual traded amount has moved to Tk. 1171.451 billion from Tk. 0.12 billion. But, the total market capitalization and annual total turnover have not been smooth at all times as DSE has suffered negative growth that of corresponding previous year, particularly in 1997-1999, 2011-2012, and 1997, 2001-2003, 2011 respectively. A continual fall down of market capitalization and turnover has observed after the collapse of the capital market in 1996 and 2010-11. Above and beyond that the overall increasing trend of market capitalization and turnover states that the indicators followed a progressive trend.

Figure 2.12 shows the size or depth of the DSE. In 1991, the market capitalization to GDP ratio has only 0.87 %, which sharply improved to 3.398 % in 1995 and all of a sudden increased to 9.303 % in 1996. Due to the massive market crash in 1996, the negative trend of market size has continued up to 1999. The increasing trend of market capitalization to GDP ratio from 1999 states that the depth of the DSE has followed a positive trend, although the ratio has touched to the double digit in 2007. After 2006, the market depth has increased progressively as the ratio has reached at 44.031 % in 2010. Although, the ratio has decreased quietly for the next 2 years mainly due to the 2nd market crash of DSE, but the value of the ratio has remained considerable. The market size of DSE is very low compared to the developed markets, such as, U.S. and U.K. stock market and even to the emerging markets, such as, K.S.A. and Indian stock market. So, market size value of less than 50% states that the DSE is undervalued.

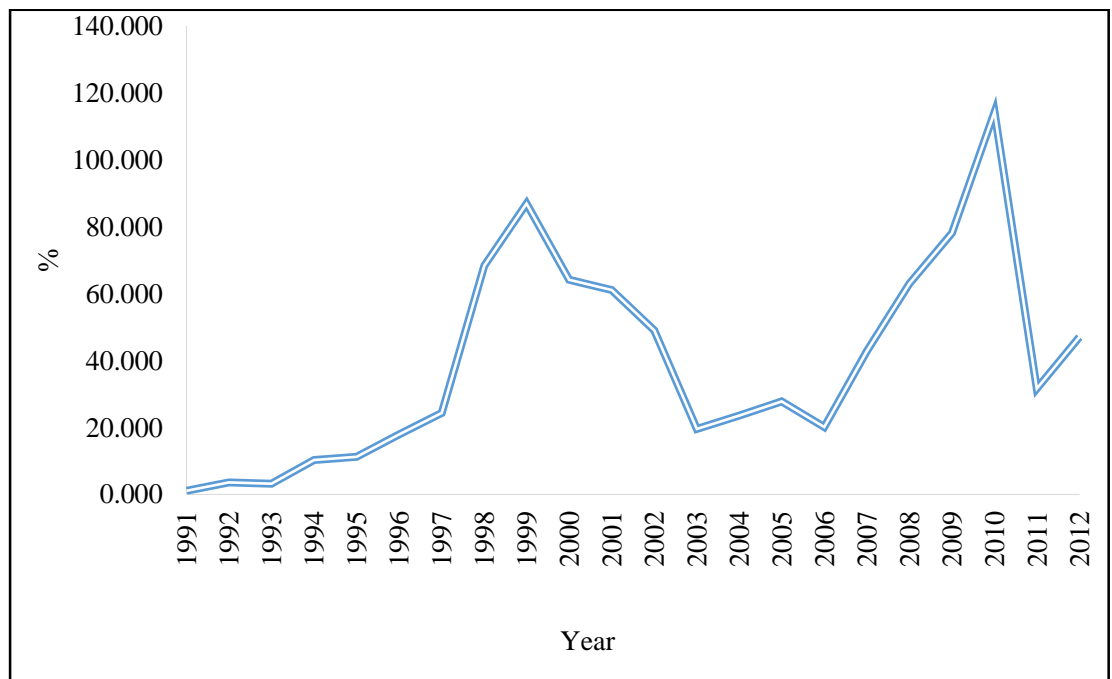
Figure 2.13 shows the liquidity of the DSE with respect to the selected comprehensive indicator named turnover ratio, i.e., the ratio of the value of shares traded to market capitalization. In 1996, the turnover ratio has 17.925 %, which has sharply increased to 87.010 % in 1999 owing to the negative trend of market capitalization followed by the massive market crash (Figure 2.13). Then again the ratio has reached at maximum of

114.307 % in 2010 as the impulsive increase in the general index has attracted to invest more in the capital market.

**Figure 2.12: DSE Market Depth, 1991 to 2012**



**Figure 2.13: Market Liquidity of DSE in terms of (T/MC)**



The extent of ups and downs in turnover ratio of the capital market mainly depends on monetary policy through the rate of interest and fiscal policy through government deficit financing. Another important reason is the market capitalization fluctuation followed by the massive market crash. Supply of liquidity become weak in the stock market under the contractionary monetary policy through a high rate of interest along with government's greater dependency on loans from the banking sector for financing public deficit (Hossain, 2013). Based on the turnover ratio, the Dhaka Stock Exchange noticeably keeps, on an average, 40 % liquidity all through the previous 24 years.

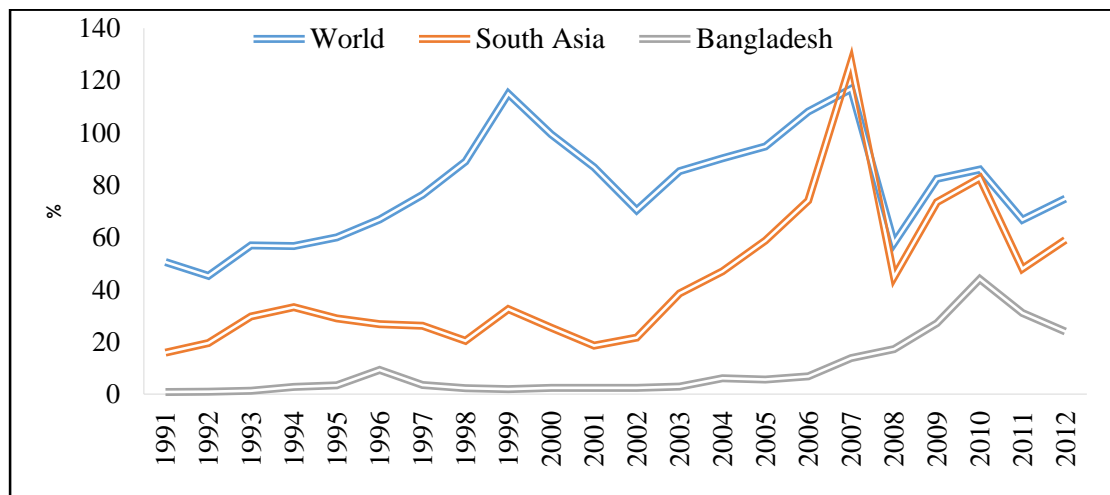
## **2.6 DSE in the World Perspective**

Based on any indicator except the growth rate in terms of economic and financial variables of the past decade, the emerging markets of South Asia stay behind than of world benchmarks. According to average annual growth of GDP, the South Asian region performs well compared with the rest of the world during the period 2000 to 2011. South Asia experiences an average 7.3% annual growth rate of GDP, while the world average is only 2.7% (World Bank, 2013). The four emerging markets of South Asia named, India, Bangladesh, Pakistan and Srilanka have grown Gross National Income (GNI) with 124.9%, 91.3%, 82.8% and 76.2% respectively from 2000 to 2011 (Khan 2013). The stock markets in South Asia show a discrepancy in terms of age and size. The Bombay Stock Exchange (BSE) of India and Colombo Stock Exchange (CSE) of Srilanka have established in 1875 and 1896 respectively, while Karachi Stock Exchange (KSE) of Pakistan and Dhaka Stock Exchange (DSE) of Bangladesh have established in 1947 and 1954 respectively. Although stock markets of these countries are not new to the job, but the markets have functioned and performed well after the process of liberalization in early 1990s.

Figure 2.14 and 2.15 give a visualization of the stock market of Bangladesh associated with South Asian and World perspective. Data of the World and South Asian stock markets are collected from the World Development Indicator 2013 published by the World Bank, while data of DSE for Bangladesh are collected from Arif (2014). Based on market size, i.e., market capitalization to GDP ratio, the DSE gets pleasure from a 2659% growth between 1991 and 2012, while South Asia as a whole also maintained a

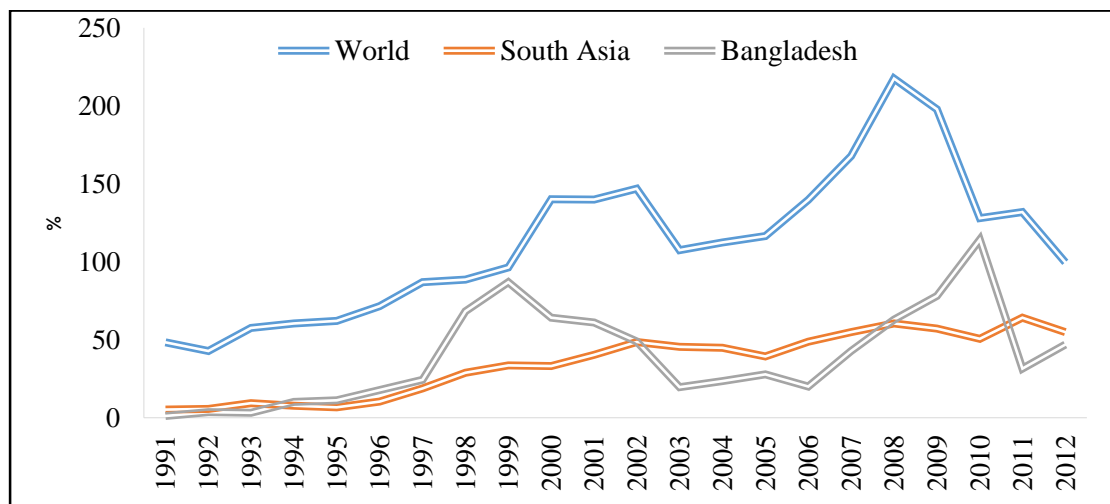
272% growth in contrast with only 49% growth of the stock markets of the world (Figure 2.14); although, the volume of market capitalization and GDP of South Asia and Bangladesh remain well behind from the worlds' average level. Figure 2.14 shows the status of the market size of the DSE compared to the world and South Asia and that calculated by the market capitalization to GDP ratio in %age. The market depth of DSE is increased significantly from 2006 to 2012 although a long way to go to attain the world level and even the South Asian average level. In that 24 years, market size of DSE is 9.65% on an average, while market size of the stock markets of the South Asia and World are on an average 43.29% and 78.9% respectively.

**Figure 2.14: Market Depth of Stock Markets**



Source: WDI of The World Bank (2013) and Arif (2014).

**Figure 2.15: Turnover Ratio of Stock Markets**



Source: WDI of The World Bank (2013) and Arif (2014).

Figure 2.15 shows the state of the turnover ratio of the DSE compared to the stock markets of the world and South Asia, which is calculated by the value of shares traded to market capitalization ratio in percentage. In that 24 years from 1991 to 2012, turnover ratio of DSE is 39.53% on an average, while the stock markets of the South Asia and World are on an average 35.03% and 111.9% respectively. Although, over the 24 years the average turnover ratio of DSE is better than South Asian level, but Bangladesh remains well behind from the worlds' average level. The extent of ups and downs in turnover ratio of the DSE shows that the investors of the market responds by the high liquidity and finally the DSE faces the two big market crashes in 1996 and 2010-11.

Table 2.6, Figure 2.16 and 2.17 show the status of the GDP, market capitalization and market size of the selected developed and emerging markets of the world as on June 2013. Data of Nepal, UK and USA are collected from WDI of the World Bank, while rest of the countries data are collected from annual reports of SEC and DSE.

**Table 2.6: The Scenario of Capital Market in Different Countries**

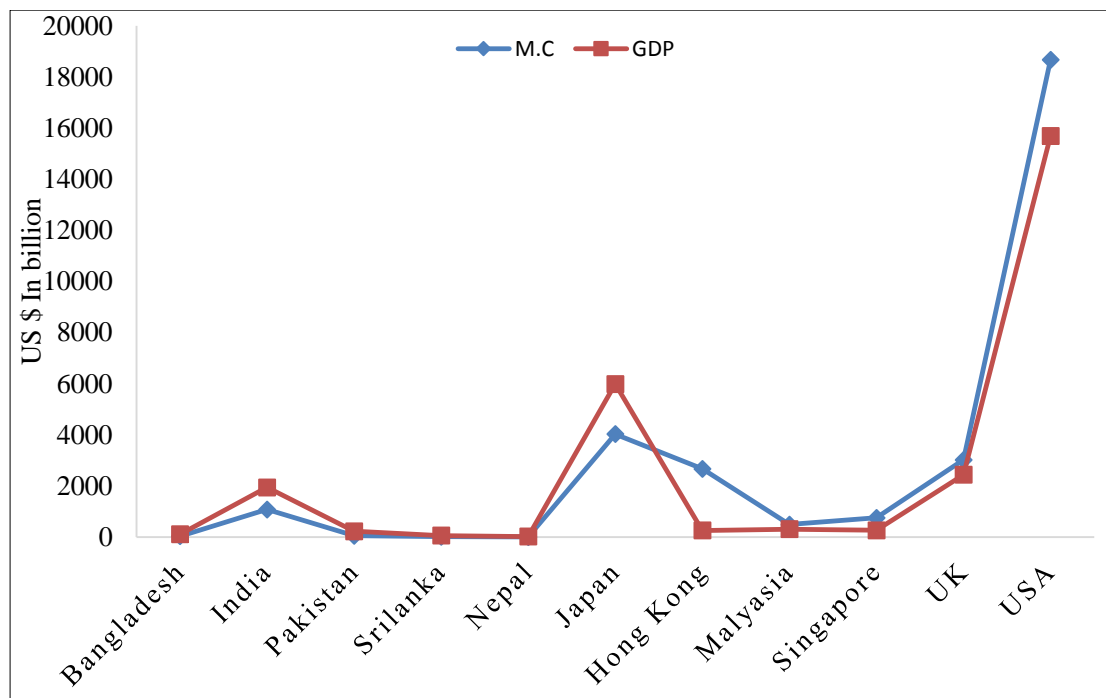
Country	Name of Index	June-2013 Index	M.C (US \$ in billion)	GDP (US \$ in billion)	Market Size =M.C/GDP in %
Bangladesh	DSE X	4385.77	32.54	111.86	29.09
India	BSE 30	18522.10	1077.85	1946.77	55.37
Pakistan	Karachi 100	21002.6	51.64	230.53	22.40
Srilanka	CSE All Share	6121.01	18.03	59.77	30.16
Nepal	NEPSI	493.13	4.16	19.35	21.4
Japan	Nikkei 225	12834	4026.07	5984.39	67.28
Hong Kong	Hang Seng	20338.6	2669.6	257.95	1034.92
Malyasia	KLSE Composite	1773.54	490.83	307.18	159.79
Singapore	Straits Times	3150.44	752.03	267.94	280.67
UK	FISE 100	6165.5	3019.47	2435.06	124
USA	DJIA	14910.1	18668.3	15687.67	119

Source: Annual Report of SEC and DSE, 2012-13 and WDI of the World Bank, 2013.



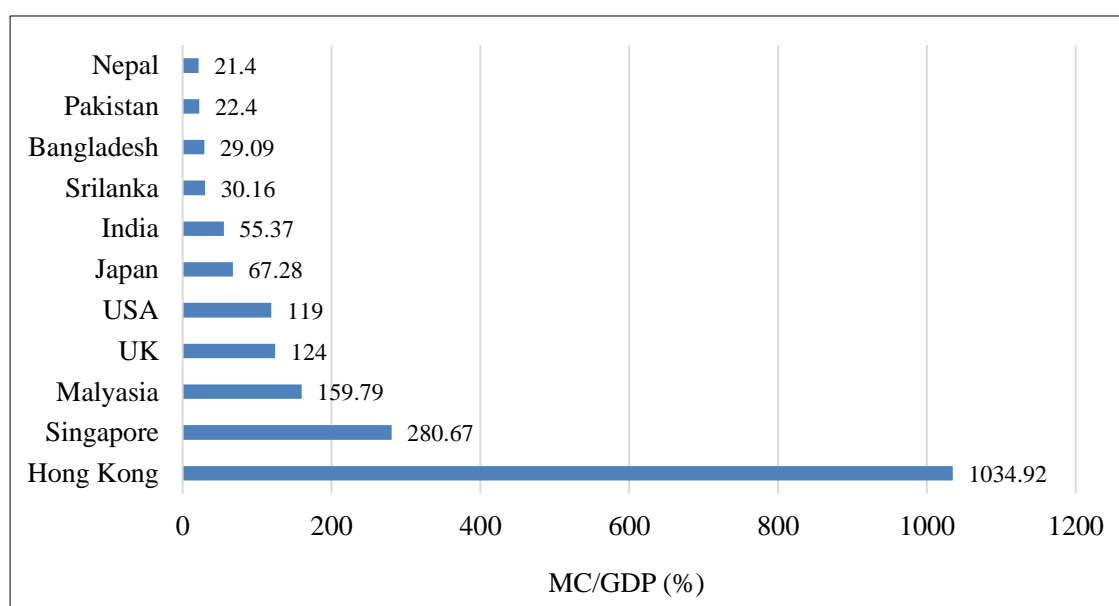
Table 2.6 shows that stock markets in the South Asia region remain small and underdeveloped compared to the six developed countries. Although Emerging economies have been growing consistently faster than developed economies for about the past 10 years, but still remain well behind in all aspects. The market capitalization to GDP ratio of Hong Kong, Singapore, Malaysia, UK and USA are 1034.92%, 280.67%, 159.79%, 124% and 119 % respectively in 2013, while the market size of Bangladesh is only 29.09 % (Figure 2.17). Hong Kong, Singapore, Malaysia, UK and USA are going through a high level of market capitalization than of its GDP among the 11 countries (Figure 2.16).

**Figure 2.16: Market Capitalization and GDP Comparison as on 2013**



India is the largest market with 55.37 % market size in the South Asian region in terms of the number of listed companies, GDP, market capitalization, market turnover and liquidity. Nepal is in the weakest position among five of the South Asian Countries with a market size of 21.4 %. But Bangladesh is progressing considerably over the years. According to Standard and Poor's (2009), Bangladesh is ranked eighth in the world according to its stock market performance in 2008, while Srilanka, India and Pakistan are ranked 57th, 71th, and 72th respectively.

**Figure 2.17: Market Size of the Stock Markets, End of June 2013**



## 2.7 Conclusion

Bangladesh has taken 44 years to improve her position from low-income category to lower-middle income category. Bangladesh still has to overcome its shortcomings in the human development index as it has been ranked 142 in the global Human Development Report 2014 among the 187 countries based on several indicators, including education, health and economic conditions. However, the optimistic news is that it is being mentioned as one of the country with huge potential and a rapidly growing economy. But, Bangladesh resumes to fight against a number of major challenges, including political and bureaucratic corruption and political instability since her independence. Political instability and unrest obviously destroy confidence among investors on the stock market. After 1991, the stock market of Bangladesh has gotten pace, but corruptions and political instability are striking our stock market harshly which resulted several turmoil in 1996 and 2010. The stock market has taken a long time to come to a stable position after the crash of 1996 even though the authorities have taken different initiatives. After the 2010-11 stock market turmoil, investors are expected that the catastrophe of the market will wipe out immediately by the measures taken by the authorities, although the responsible big patrons of both market crashes have not been punished. Rahaman et al. (2013) perform a study about the performance of the stock market under different government periods in Bangladesh from 1991 to

2013. They find that all the market indicators such as, turnover value, market capitalization, DSI, market size and turnover ratio have comparatively very significant positive growth under the periods of 1991-96 and 2006-09, while the periods of 1996-2006 and 2009-2013 have some negative growth in terms of turnover value and turnover ratio. They conclude that the political parties that are holding power in government had considerable influence on the stock market performance as the market performance changes significantly, and two big market crashes also struck during the two terms of the same government.

The major findings from the above analysis of the overview of the DSE may be summarized as follows:

- The total number of enlisted securities is increasing at a handsome rate, although 151 treasury bonds are listed in DSE that have actually no impact on the market. Moreover, there is a shortage of healthy fundamental companies in terms of the greater demand over supply of companies share in the Dhaka stock exchange as BO accounts is increased from 3 lacs in 1996 to 35 lacs in 2010.
- The DSE is not succeeding to become a capital market as it is still an equity based market. One of the important aspect of capital market is bond market, which is not developing due to lack of good policy framework.
- The stock market indicators like market size and market liquidity are increasing impressively since more than last two decades. But the market size and liquidity are really too low compared to most of the stock markets of the low and middle income countries. Market capitalization increased substantially from FY 2010 as the single largest capitalization stock named Grameenphone Ltd. has listed on DSE. Market concentration is extreme as Grameenphone holds 16.58% of total market capitalization of the DSE as of December 2009.
- Foreign portfolio investment in the country's capital market improved substantially as it boosted almost three times to Tk. 2.3 billion in May 2013, from around Tk. 800 million in the previous month, according to the net position of portfolio investment taken from Dhaka Stock Exchange records. However, foreign investment makes only around 2% of total investment at DSE, which is the lowest in South Asia region.

- From the commencement, Dhaka Stock Exchange has faced two major market crashes in November 1996 and December 2010. A number of dissimilarities in the status of the market have observed in 2010-11 compared with 1996 collapse. During the crash of 1996, paper shares used to be sold in front of DSE and it was not easy for amateur investors to classify which one is profitable share and which one is fake printed share. In spite of automated share trading, strong surveillance and circuit breakers contrasting formerly in 1996, DSE is strongly affected by the 2nd market crash in 2010-11. Based on the contemporary investigations of the capital market crashes, various malfunctions and drawbacks are observed like misuse of book building methods, placement shares, direct listing, problems in audit reports, split shares, margin loans, serial trading, issue of right shares, over exposures of banks, omnibus accounts, insider trading, anomalies in BO account, and hampering nexus of big players like the SEC, DSE, CSE and political leaders.
- A lot of steps have taken by the government after the recent market crash to improve the market condition. A meaningful reform program partnered by the Asian Development Bank (ADB) have launched under the Second Capital Markets Development Program (CMDP2) in November 2012 and the new automated surveillance system has also been introduced in December 2012. In the final quarter of 2012, SEC has introduced a roadmap for capital market of Bangladesh. The roadmap is a 10-Year Master Plan aimed to make a systematic development of the market. Demutualization of Stock Exchanges has finalized. A new method for the calculation of share price index has introduced to help of Standard & Poor's.

Even though the stock market indicators of the DSE remain low compared to international standards, but the growth rate of that indicators over the years in spite of the market crashes suggest that Bangladesh has a lot of potentials. Government should encourage securities segment than non-securities segment of the financial system in order to reduce the dependency on bank based credit, then new instruments will enter into the market to increase the attraction of the investors, and as a result the size, volume and liquidity of stock market must reach the sizeable level.

## Chapter 3

### Theoretical Framework

#### 3.1 Introduction

In this Chapter, the asset pricing models are compressed with the intention of giving a theoretical overview of this study. The theories of economics and finance have constructively contributed to the real economy, and enriched the literature over the years. This is why, some economists have achieved the prestigious Nobel Prize for their theoretical and empirical contribution in financial economics. For example: Tobin in 1981 for his analysis of financial markets and their relations to expenditure decisions, employment, production and prices, Modigliani in 1985 for his pioneering analysis of savings and financial markets, Markowitz, Miller and Sharpe in 1990 for their pioneering work in the theory of financial economics, Merton and Scholes in 1997 for a new method to determine the value of derivatives, Fama, Hansen and Shiller in 2013 for their empirical analysis of asset prices win Nobel Prize. The existing theories of financial economics have provided a number of models explaining the link between stock market behavior and economic activity. Empirical studies have investigated the stock market behavior from the perspective of the Efficient Market Hypothesis (EMH) and the theory of asset pricing such as Portfolio Theory, Capital Asset Pricing Model (CAPM), Present Value Model (PVM) and Arbitrage Pricing Theory (APT). The theoretical basis of this research is consistent with the EMH and the most prominent equilibrium asset pricing model named APT.

The chronological theories of asset price behavior start with the straightforward economic theory of price determination named the 'law of supply and demand'. However, financial assets trading are different with any other ordinary commodities; the law of supply and demand is also attached to the asset markets. The stock market index or portfolio consists of individual stocks. Bailey (2005) specifies that the market equilibrium at each date is defined by a set of asset prices and a portfolio of assets among investors with the following two constraints:

- i. Each investor's portfolio is determined according to the investors's decision rule, and
- ii. The total supply of each asset equals the total demand aggregated over all investor.

But, it should be noted that the price determination of assets has not always maintained the above mentioned rules. Fisher's Separation Theorem is still a fundamental idea of finance. According to Fisher (1930), the share price should rise, fall, or remain stable depending on the interrelationship between company's project returns and the shareholders desired rate of return.

The asset market prices are also influenced by information, opportunity cost, risk or uncertainty, economic variables, and most importantly the rate of return. What factors can determine the price of assets has been a major question involving researchers in the field of financial economics. In the following subsections we display a number of existing theories of asset pricing that emerge to answer the fundamental question.

The remainder of the current Chapter is organized as follows. Section 3.2 presents the Efficient Market Hypothesis (EMH), Section 3.3 reviews the Portfolio Theory, while section 3.4 and 3.5 arrange for Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT) respectively. Section 3.6 provides a brief review of Present Value Model (PVM) and Section 3.7 concludes the Chapter.

### **3.2 Efficient Market Hypothesis (EMH)**

The Efficient Market Hypothesis is probably the most dominant and well-known market theory in the world. Economists are mostly concerned with three types of efficiency in the capital market. These are allocational (Pareto) efficiency, operational efficiency and informational efficiency. Allocational efficiency is concerned with the transfer of funds from savers to borrowers in the most productive manner. Operational efficiency the level of costs in carrying out transactions in the capital markets. Informational efficiency refers to the extent to which all available information are incorporated into the prices of securities. The degree of allocational efficiency depends on both operational and informational efficiency, while financial market can

be informationally efficient without being allocationally or operationally efficient. Usually, the empirical efforts of testing stock market efficiency emphasis on the informational market efficiency.

The concept of efficient capital market has not emerged all of a sudden in the 1960s. It has slowly evaluated from the independent works of several economists, and these contributions have succeeded by Fama's (1965) definition of Efficient Market Hypothesis. In the same year, Paul A. Samuelson provides the first formal economic argument for efficient markets focusing on the concept of a martingale, while Fama defines an efficient market for the first time and concludes that the stock prices follow a random walk. The EMH states that stock market prices already incorporate and reflect all available information such that none can beat the market by making abnormal profits (Fama 1965). A stock market is said to be efficient if stock prices in that market reflect all available information. Alshogeathri (2011) uses equation (3.1) to explain the EMH:

$$\Omega_t^* = \Omega_t \quad (3.1)$$

where  $\Omega_t^*$  is a set of relevant information available to the investors at time 't' and  $\Omega_t$  is the set of information used to price assets at time 't'. The equivalence of these two sides implies that the market is efficient.

In 1970, Fama publishes his second milestone paper titled "Efficient capital markets: A review of theory and empirical work" in which he elaborates three different levels of market efficiency based on the terminology of his colleague Harry Roberts. Fama (1970) mentions that EMH exists in various degrees: weak, semi-strong, strong and successively he accomplishes an important contribution in making the efficient market hypothesis testable. The weak form of EMH assumes that past stock prices are not significant to make an abnormal return. The semi-strong form of EMH assumes that no investor can earn abnormal returns using publicly available information. Finally the strong form of EMH assumes that all public and private information are reflected by present stock prices.

In practice, there are four different methods exercised to test the EMH. The methods are depicted as:

- i. **Technical Analysis:** Technical analysis is related to test the weak form efficiency of the EMH, and uses past stock price behavior. Technical analysis is not concerned with company fundamentals. Analysts seek to determine the future price of a stock based solely on the trends reflected in the past prices. The hypothesis of weak market efficiency is associated to the random walk hypothesis (RWH). The RWH states that the stock price of tomorrow is independent of today's price and thus past prices cannot be helpful to forecast the future prices. As a result, investors can not earn the abnormal profit by detecting trends or patterns based on historical data of stock prices. If a stock market follows a random walk, then the market is said to be efficient in weak form that rules out the use of technical analysis.
- ii. **Fundamental Analysis:** Fundamental analysis is related to test the semi-strong form efficiency of the EMH and uses all publicly available firm-specific information including historical data of stock prices. It is the microeconomic version for testing the semi strong form efficiency of EMH. A stock market is said to be efficient in semi strong form if no investor can earn abnormal profit using firm-specific publicly available information such as price-earning ratio, share split, dividend declaration etc.
- iii. **Macroeconomic Analysis:** Macroeconomic analysis is also related to test the semi strong form efficiency of the EMH and uses all publicly available macroeconomic information including historical data of stock prices. A stock market is said to be efficient in semi strong form if no investor can earn abnormal profit using publicly available global and domestic macroeconomic information such as GDP, interest rate, exchange rate, money supply, foreign stock markets index etc.
- iv. **Mutual Funds and Insider Trading Behavior Analysis:** It is associated to test the strong form efficiency of the EMH and uses private information. Inside traders are generally allowed some private information as managers of mutual funds have access to companys' issues from time to time. A stock market is said to be efficient in strong form if no investor can earn abnormal profit using such private information.



The efficient market hypothesis remains the central concept of financial economics despite of many rejections in empirical tests. Mobarek and Keasey (2000) examine weak-form market efficiency of DSE using the daily price indices of all the listed securities on the DSE for the period of 1988 to 1997. They use both non-parametric tests (Kolmogorov –Smirnov normality test and run test) and parametric tests (Auto-correlation test, Auto-regression, ARIMA model), and find that the share return series do not follow random walk model, and the significant autocorrelation coefficient at different lags reject the null hypothesis of weak-form efficiency.

Leigh (1997) examines the three forms of EMH in the stock market of Singapore, and the relationship between the stock market and the overall economy using quarterly data from 1975 Q1 to 1991 Q2. Employing unit root tests, he shows that the stock returns of Singapore stock market follow random walk model, therefore the market is efficient in weak form. Based on Johansen- Juselius Cointegration model, the study finds that there is no cointegration between stock prices and macroeconomic variables. Thus, he comments that the stock market follows semi strong form of EMH. Moreover, the study operates ECM and finds that stock market of Singapore does not follow the strong form of EMH. The Granger causality test suggests that Singapore stock market index can be used as a leading indicator of the economy. Finally, ARCH and GARCH model are used to test the excess volatility, and the results find no significant evidence of asset pricing inefficiency in Singapore stock market.

Khan and Ikram (2011) examine the strong form of efficient market hypothesis in Indian capital market by comparing the various schemes of different mutual funds with the index of NSE (S&P CNX Nifty) taking it as a benchmark indicator over the period from 1 April 2000 to 30 April 2010. Daily NAV (Net Asset Value) data of mutual funds and daily closing prices of S&P CNX Nifty are used for employing risk and return analysis, Sharpe's measure, Treynor's measure, Jensen's measure in order to evaluate the performance of mutual funds against the benchmark to appraise the efficiency of Indian capital market. The results of this study suggest that the Indian capital market is not strong form efficient, as the fund managers are making use of the inside information in order to earn abnormal return.

### 3.3 The Portfolio Theory

The pricing of financial assets based on the expected return and risk of a portfolio originates from Markowitz's (1952) Modern Portfolio Theory. The portfolio theory is also known as the mean-variance analysis offers a lifeline in financial economics because it provides a practical method for construction of portfolios. Portfolio theory integrates the EMH and rational expectations hypothesis. Basically, it is a theory of individual behavior that introduces two assumptions:

- i) Investors are risk-averse individuals and mean-variance optimizers, and
- ii) The market is perfect and frictionless.

Based on the theory, efficient portfolios can be chosen by the investors that maximizes

$$G = G(\mu_p, \delta_p^2) \tag{3.2}$$

subject to the constraint that the total value of assets calculated at initial prices does not exceed initial wealth.

where  $\mu_p$  is the expected rate of return and  $\delta_p^2$  is the variance of return on the portfolio.

So, in a mean-variance analysis, investors should go in pursuit of either maximum expected return for a given level of risk or minimum risk for a given expected return. Markowitz (1952) explains why investors who seek an efficient portfolio cannot rely on mean-variance criteria alone. Thus, he formulates the theory of optimal portfolio selection focusing on diversification as a method of reducing risk. There are two types of risk are involved, i.e., systematic and unsystematic risk. Unsystematic risk is generated mainly by microeconomic factors specific to the individual firms, securities, and projects, while systematic risk is generated mainly by macroeconomic factors that affect all firms and securities. Portfolio diversification is a useful tool to minimize the unsystematic risk, whereas systematic risk cannot be minimized by diversification of securities. Therefore, Modern portfolio theory (MPT) or portfolio theory of Markowitz (1952) states that investors should select portfolios that lie on the efficient frontier and obviously they should select portfolios, not individual securities.

Tobin (1958) contributes to the portfolio theory and expands on Markowitz's work by adding a risk-free asset to the analysis and explains how the introduction of risk-free investments once again reduces portfolio risk. Tobin contends that agents would diversify their savings between a risk free asset (money) and a single portfolio of risky assets.

Though Markowitz is generally acknowledged as the father of modern portfolio theory, the theory has not been tested empirically by so many scholars. Plessis and Ward (2009) find a strong evidence that the Markowitz optimal portfolio does provide the basis of a useful trading rule strategy. Sarker (2013) attempts to find out the optimal portfolio using Markowitz model using monthly closing prices of 164 companies listed in DSE, and DSE all share price index for the period of July 2007 to June 2012. Sarker (2013) finds that the optimum portfolio consists of 20 stocks are giving the return of 6.48%, while 23 companies are showing negative returns, and the other 157 companies are showing positive returns. Finally, the researcher concludes that Markowitz Model performs well in Dhaka Stock Exchange as well as Bangladesh stock market. In contrast, McLeod (1998) argues that portfolio managers believe that the Markowitz model gives unrealistic portfolios, which are not properly diversified.

### **3.4 Capital Asset Pricing Model (CAPM)**

Sharpe (1964) extends Markowitz's portfolio theory, and develops the Capital Asset Pricing Model (CAPM) that contribute by Lintner (1965) and Mossin (1966). The CAPM model provides an equilibrium asset pricing model of market behavior as a whole and assumes that investors to be utility maximizing agents, while all investors behave in the same manner. The capital asset pricing model excludes unsystematic risk factors and decomposes a portfolio's risk into systematic and specific risk. Systematic risk is the risk of holding the market portfolio. Specific risk is the risk which is unique to an individual asset. Systematic risk can be measured using beta ( $\beta$ ). The CAPM is known as the single factor asset pricing model that integrates only one macroeconomic variable through the value of beta ( $\beta$ ). The following equation is the basis of this model:

$$E(R_i) = R_f + \beta[E(R_m) - R_f] \quad (3.3)$$

where  $E(R_i)$  is the expected return of the asset in question;  $R_f$  is the risk free return

rate;  $R_m$  is the market risk; and  $\beta$  is the sensitivity of the particular share to movements in the market return. Formally,  $\beta$ 's definition is:

$$\beta_i = \frac{\text{Cov}(R_i, R_m)}{\sigma_m^2} \quad (3.4)$$

where  $R_i$  is the return of the asset,  $R_m$  is the return of the market portfolio, and  $\sigma_m^2$  is the variance of the market portfolio.

CAPM simply explains that expected return of the stock should equate the risk free rate plus the coefficient multiplied by the market risk premium. As a result, the expected return on a particular investment is determined based on its contribution to the market portfolio's risk. Sharpe receives the Nobel Prize in 1990 for his work on the CAPM, when the Sharpe ratio gets popularity. The ratio describes how much excess return the investor is receiving for the extra volatility that he is experiencing for holding a riskier asset. The ratio is as follows:

$$S(x) = \frac{(R_x - R_f)}{\sigma_x} \quad (3.5)$$

where  $x$  is the investment,  $R_x$  is the average rate of return of  $x$ ,  $R_f$  is the risk-free return and  $\sigma_x$  is the standard deviation of  $R(x)$ .

The effectiveness of the CAPM is empirically tested in a series of papers. Rahman (2012) investigates the application of zero Beta CAPM in the context of Dhaka Stock Exchange (DSE) using weekly data of 87 publicly listed shares from 2000 to 2008. He tries to measure the reward for taking risk at DSE by assuming absence of risk free rate and residing within mean variance point of view of portfolio evaluation. The study reveals that statistical relationship between taking risk and return is negative and statistically significant.

In contrast, Fama and MacBeth (1973) notice a positive simple relation between average stock return and beta in US stock prices. Yan-Leung and Ka-Tai (1992) empirically test CAPM in the Hong Kong stock market for the period from 1980 to 1989 and find the weak evidence of CAPM.

On the other hand, Rahman et al. (2006) examine whether CAPM is a good indicator of asset pricing in Bangladesh and find support for CAPM. They reveal that the beta has useful information in the context of DSE.

### 3.5 Arbitrage Pricing Theory (APT)

The Arbitrage Pricing Theory (APT) is developed by Ross (1976) that expands the original CAPM from a single-factor to a multi-factor model. APT states that a number of systematic risk factors that are generated by the variations of macroeconomic and financial variables which determine the market return. This theory starts with an analysis of how investors build efficient portfolios and states that the return on any risky asset is a linear combination of various macroeconomic factors. The theory is basically based on two concepts, i.e., the generation of returns and the principle of arbitrage. The APT can be written in equation as:

$$E(R_i) = R_f + \beta_1 R_1 + \beta_2 R_2 + \beta_3 R_3 + \dots + \beta_n R_n + \varepsilon \quad (3.6)$$

where  $E(R_i)$  is the expected return of stock  $i$ ;  $R_f$  is the risk free rate of return;  $\beta_i$  are the stock sensitivity to factor  $n$ , also known as factor loading; and  $R_i$  are the risk premium factors included in APT model; and  $\varepsilon$  is the error term or the other factors that may have some affect.

Two versions are used to test and implement APT. Factor loading version uses artificial variables related statistical (i.e., principal component analysis, factor analysis) techniques, while macro variable version uses economic factors. The APT is the most popular asset pricing model that is empirically investigated by a significant number of researchers as it grants the freedom to select variables to the economy. The systematic risk factors may be economic factors such as interest rates, inflation, GDP, and financial factors such as market indices, yield curves, exchange rates. Factors may also be fundamentals like price-earnings ratios, dividend yields, etc. Chen and Jordan (1993) use both the version of APT, named factor loading and macroeconomic variable model to predict portfolio return for the period 1971 to 1986. They conclude that the macro variable model is the best model as it includes economically interpretable factors.

APT has been tested intensively since its introduction in 1976. Chen, Roll, and Ross (1986) test seven macroeconomic variables, namely, term structure, industrial production, risk premium, inflation, market return, consumption, and oil prices in the period of January 1953 to November 1984 to explain the U.S stock return. They reveal that several of these economic variables are significant in explaining expected stock return.

Isenmila and Erah (2012) examine the appropriateness of the APT to give reasons for stock returns in Nigeria for the period 2000 Q1-2010 Q4. The study examines the implication of oil prices (OP), money supply (M2), Gross Domestic Product, Exchange rate (ER), inflation, and interest rate (IR) in explaining stock returns (All share index) of the Nigerian stock market. The cointegration and error correction methodology reveal that M2 and OP are emerged to be negative significant determinant, while ER and IR are observed to be negative insignificant determinant of stock returns both in the long run and the short run. They recommend that the APT macroeconomic variables can explain stock returns and thus there is the need for practical harmonization of macroeconomic policies in Nigeria.

### **3.6 Present Value Model (PVM)**

The present value model is the most basic description of rational asset pricing. According to the linear PVM, stock prices are fundamentally determined by the discounted value of their future dividends, which derive their value from future expected earnings (Campbell et al., 1997). Given the assumptions of rational expectations, risk-neutrality and market equilibrium, the movement of shares prices over time is yielded by the PVM of future cash flows:

$$P_t = \frac{1}{1+R} (E_t P_{t+1} + E_t D_{t+1}) \quad (3.7)$$

where  $P_t$  is the real price of a share at time  $t$ ,  $D_t$  is the real dividend paid on the stock in time period  $t$ ,  $\frac{1}{1+R}$  is the discount factor,  $R$  is the constant expected stock return ( $E_t [R_t + 1] = R$ ) and  $E_t$  is the expectations operator conditioned on information up to  $t$ .

The present value model of dividends can be used to prompt macroeconomic variables that may perhaps guide share prices. As can be seen in equation 3.7, the current stock price should be a function of expected dividends or earnings, and the discount rate. Hence, any macroeconomic variable that is correlated with corporate earnings, growth rates or the discount rate might be helpful in predicting stock prices.

The present value model has been very popular in empirical research as it is a basis of financial theory. For instance, Campbell and Shiller (1987) estimate the present value relation of the aggregate S&P 500 price level with its dividend stream from 1871 to 1986. The assessment of the PVM for stocks shows that the spread between stock prices and dividends moves too much and deviations from the PVM are quite persistent. Nasseh and Strauss (2004) estimate the long-term relationship between dividends and share prices for individual securities in the S&P 100. Applying panel cointegration approach, they comment that the results stay in favor of the present value model. They find that there is a close link between stock prices and dividends for most of the sample period.

### **3.7 Conclusion**

In this Chapter, we provide a theoretical overview of asset pricing theory. We start with EMH and find evidences in the literature in favour of weak form of EMH and semi-strong form of EMH particularly in developed markets. Then we review the Markowitz portfolio theory and find some strong evidences that the Markowitz optimal portfolio does provide the basis of a useful trading rule strategy. We also outline the Capital Asset Pricing model. This model is a single factor equilibrium model and predicts that the expected return of an individual security is a function of the risk-free rate, the expected return of the market portfolio and the beta factor of the individual security. We have also discussed the Arbitrage Pricing Theory. APT has been tested intensively since its introduction in 1976. Although empirical studies have suggested that APT macroeconomic variables can explain stock returns, it does not specify the number of variables that should be included in the multivariate efficiency and volatility models, and they are also disappointed to identify a definite guideline for choosing an appropriate set of macroeconomic variables. Finally, the present value model has been explained. Although, the extended version of PVM allows to identify macroeconomic

variables that should impact corporate cash flows and discount rates, the linear PVM mainly focuses on the relationship between real stock prices and dividends. Since this research is aimed to macroeconomically investigate the efficiency and volatility of stock market in Bangladesh, we have come to a decision to follow the Efficient Market Hypothesis and Arbitrage Pricing Theory. In the next Chapter, the empirical studies are examined with the intention of giving an extensive overview of this study. Subsequently in Chapter 5, we specify the number and type of variables that are included in this study based on the EMH, APT and empirical literature reviews.



## **Chapter 4**

### **Review of the Literature**

#### **4.1 Introduction**

In this Chapter, the empirical studies are compressed with the intention of providing a comprehensive overview of the topic. The empirical studies of economics and finance have investigated the stock market behavior from the perspective of the Efficient Market Hypothesis (EMH) and the theory of asset pricing, and unquestionably the studies have enriched the literature over the years. In the last 50 years, numerous studies have researched the dynamic relationships between stock market behavior and economic activity employing different methods in terms of distinct hypothesis. It is not practicable to review all the literature in every dimension for this study. We have reviewed the studies that satisfy the following three conditions:

- i. the issue of stock market efficiency;
- ii. the relationship between stock prices and macroeconomic variables; and
- iii. the issue of stock market volatility.

The remainder of this Chapter is organized as follows. The section 4.2 reviews studies related to developed economies; section 4.3 provides studies related to developing economies; section 4.4 provides studies related to multiple countries; and section 4.5 presents studies related to Bangladesh. Section 4.6 reports conclusion of the Chapter.

#### **4.2 Studies Related to Developed Economies**

Schwert (1989) explores the relationships between the U.S. stock market volatility and real and nominal macroeconomic volatility using monthly data from 1857 to 1987. This research is regarded as one of the pioneer studies in the area. He concludes that macroeconomic volatility (changes in real output and inflation) do not help to predict stock and bond return volatility. However, Schwert provides evidence that the volatility

of financial assets helps to predict future macroeconomic volatility. The study also reveals that financial leverage affects stock volatility and there is a relation between trading activity and stock volatility. So, the overall findings support his claim that the prices of speculative assets should react quickly to new information about economic events.

Malliaris and Urrutia (1991) make an effort to find out the relationship among real (IPI), monetary (M1), and financial variables (S&P 500 Index) of the U.S economy using Granger causality tests. Using monthly data from January 1990 to June 1989, they show that money supply and S&P 500 index put on a display of causality and the tests of lead-lag relationship show that money supply gives the impression to lead the S&P 500 index, while S&P 500 index appears to lead IPI.

Groenewold and Kang (1993) examine the weak form efficiency of the Australian stock market using share index return employing autocorrelation test and unit root tests. Moreover, they investigate the semi- strong efficiency of the Australian stock market using data of the aggregate share price indices and macroeconomic variables. By using 1980s data, both the tests reveal that the Australian stock market is consistent with the EMH.

Najand and Noronha (1998) determine the existence and direction of the causal relationship between real stock returns, and rate of inflation, real interest rates, and growth in industrial production in Japan from January 1977 to December 1994 employing the state space procedure. The results indicate that inflation appears Granger-causally prior and helps explain negative stock returns in Japan.

Chiang and Doong (1999) test the relation between stock excess returns and macroeconomic factors volatility of the Taiwan industrial data covering from January 1987 to December 1996 by employing the traditional GARCH (1, 1)-M model. The results reject the hypothesis that stock excess returns are independent of the volatility of macroeconomic factors. The study also reveals that the real output volatility is more dominant in explaining the excess returns, although other sources of volatility have

some explanatory power, while the macro volatilities are divided into real (domestic output) and financial (exchange rate) components.

Kwon and Shin (1999) investigate whether macroeconomic variables such as IPI, ER, TB and M1 can explain stock market returns of the monthly stock prices of the value-weighted Korea Composite Stock Price Index and Small-size Stock Price Index for the period from January 1980 to December 1992 by using cointegration and Granger causality test. This study finds that stock price indices are cointegrated with production index, exchange rate, trade balance, and money supply that specifies a direct long-run equilibrium relation with each stock price index. But, the stock price indices are not a leading indicator for economic variables in Korea.

Cavallo and Mammola (2000) explore whether the Italian index option contract MIBO40 of the Italian Derivatives Market is efficient. The put–call parity test speaks up for the hypothesis of market efficiency and the simulation of an ex-post volatility hedging strategy also supports the hypothesis of efficiency of the MIBO40 market. Moreover, the study asserts that implied volatility constitutes a better predictor of effective volatility.

Claessen and Mittnik (2002) use daily DAX index returns from February 3, 1992 to December 29, 1995 of Germany options markets applying GARCH models to predict the future return volatility. The study reveals that past returns of options do not comprise useful information as the volatility expectations are reflected in option prices. So, the efficient market hypothesis for the DAX-index options market is well-founded. They conclude that implied volatility is a biased but highly informative predictor for future volatility.

In his paper, Binswanger (2004) considers bivariate and trivariate VAR models for the U.S to evaluate the importance of fundamental shocks in explaining stock price movements. Seven models are used in which models I to IV are bivariate models that include real stock prices and one fundamental variable that is either an indicator of real activity (GDP or industrial production) or a cash flow variable (real dividends or earnings), while the trivariate models V and VI include real interest rates as a further

fundamental variable additional to GDP (model V), and earnings (model VI). Model VII includes earnings and dividends as fundamental variables. Based on quarterly data from 1953 January to 2002 December, the results show that models using real activity variables dispose more significance on fundamental shocks than models using dividends or earnings. Though, according to all models, fundamental shocks turn out to be substantially less important during the period 1982–2002 compared with 1953–1982.

Laopodis (2004) examines whether Greece's financial market liberalization efforts have any effects on the efficient operation of the Athens Stock Exchange (ASE). Several tests for structural change, market integration, and efficiency for daily stock returns from January 2, 1985 to December 30, 2001, suggest that the ASE is weak-form efficient and is operating as a random walk even before any market liberalization announcements are made. Overall, the results suggest that foreign and domestic investors are mostly guided by fundamentals.

Athanassiou, Kollias and Syriopoulos (2006) analyze the impact of symmetric and asymmetric volatility effects on the Athens Stock Exchange employing alternative GARCH models. Particularly, the focus is on the impact of fluctuations in Greek-Turkish bilateral relations on the Athens Stock Exchange. The empirical findings inform that the impact of asymmetric leverage effects is statistically acceptable.

DePenya and Gil-Alana (2007) investigate the efficiency of the Spanish Stock Market indexes namely, IGBM (Indice General de la Bolsa de Madrid) and IBEX35 over the period from 4 January 1966 and 14 January 1987 respectively to 31 March 2002. The results show that the Spanish equity indexes (IGBM and IBEX45) are predictable until 1997 on a daily basis, but not after that date. So the stock returns of the Spanish Stock Market are followed EMH after 1997.

Kazi (2008) employs cointegration analysis to find the systematic risk factors in Australian stock market using a set of variables that are the representative of the money market, the goods market, and the global stock market. The industrial production index is considered to represent the goods market. The money market is represented by the bank variable interest rate which is also linked to the exchange rate

representing the foreign exchange market. The security market is represented by the stock price index, which is also linked to the dividend yield and the price earnings ratio. The global stock market influence is represented by the performance of the global index MSCI. The findings show that bank interest rate, corporate profitability, dividend yield and industrial production are the influential risk factors that have an effect on the stock market returns; whereas in the short-run, stock prices are adjusted each quarter by its own performance, interest rate and global stock market movements of the previous quarter.

Kumar and Dhankar (2010) investigate the presence of conditional heteroskedasticity in time series of US stock market returns, and the asymmetric effect of good and bad news on volatility and thereafter, testing the relationship between stock returns with expected volatility, and unexpected volatility employing GARCH (1, 1) and T-GARCH (1, 1) models. Further, the study also analyzes the relationship between stock returns, conditional volatility and standard residuals. The daily opening and closing prices of S&P 500 and NASDAQ 100 are used for the period from January 1990 to December 2007. The results of the study suggest the presence of the heteroskedasticity effect and the asymmetric nature of stock returns. Further, the study reveals a significant negative relationship between stock returns and conditional volatility. Finally, they conclude that investors adjust their investment decisions with regard to expected volatility; however, they expect extra risk premium for unexpected volatility.

Dicle and Levendis (2011) evaluate the Athens Stock Exchange efficiency both on the market and on the individual stock level. Evidence of inefficiencies is found both on the market level and on the individual level. The study reveals that about 94% of Greek stocks' returns are Granger caused by at least one foreign market. So, they conclude that the Greek market lacks the appeal for international diversification.

Hsing (2013) examines the impact of selected macroeconomic variables (industrial production as a proxy of real output, government deficit, domestic real interest rate, money supply, exchange rate, expected inflation rate and US S&P 500 index) on the Japanese stock market index based on a sample during 1975-2009. This paper gets that the Japanese stock market index is positively influenced by industrial

production, is negatively related to the government deficit, domestic real interest rate and expected inflation rate, and displays a nonlinear relationship with the money supply and nominal effective exchange rate.

Charles and Darné (2014) identify the events that cause large shocks in the volatility of the Dow Jones Industrial Average (DJIA) index of U.S between October 2, 1928 and August 30, 2013. Employing the semi-parametric procedure, the study finds that the large volatility shocks are mostly due to the major financial crashes, the US elections, wars, monetary policies during the recessions, macroeconomic news and declarations on the economic situation, terrorist attacks, bankruptcy and regulation. They conclude that these large shocks should be taken into account in modeling volatility of returns together within macro-finance models.

### **4.3 Studies Related to Developing Economies**

Naka, Mukherjee and Tufte (1988) analyze the relationships among selected macroeconomic variables (Industrial Production Index, Consumer Price Index, a narrowly-defined money supply, and the money market rate in the Bombay interbank market) employing VECM method developed by Johansen (1991). Results suggest that industrial production is the largest positive determinant of Indian stock prices, while inflation (CPI) is the largest negative determinant.

Mecagni and Sourial (1999) examine four indices of the Egyptian stock market (ESM) to test the efficiency and volatility by using GARCH (p,q) model. Results indicate that the stock market does not follow the EMH. Stock returns of the Egyptian stock market exhibit volatility clustering, and volatility is a significant determinant of returns as there is a significant positive link between risk and return.

Ali and Khalid (2001) examine the linkage of “information” i.e., news published in the national newspapers (the daily Business Recorder and the daily Dawn) with aggregate stock market activity measured by market returns and trading volume. From the analysis of correlation coefficient and univariate regressions, the study reveals that there are a contrasting results between relationship of volume and returns with publicly available news. At aggregate level, the news surprises and number of news are

negatively related to stock market activity in Pakistan. This relationship is statistically significant in case of trading volume, but insignificant in case of stock returns.

Siourounis (2002) employs GARCH type models to test efficiency and volatility on the Athens Stock Exchange Market (ASE) using daily data from 1 January 1988 to 30 October 1998. The result of EGARCH-M implies that the weak efficient market hypothesis do not hold for ASE. LGARCH (1, 1) model shows that negative shocks have an asymmetric impact on the daily stock returns series, and GARCH (1, 1) model reveals that volatility increases by political instabilities over time.

Balkiz (2003) investigates the weak form test of informational efficiency of the Kuala Lumpur Security Exchange (KLSE) in terms of the daily Composite Index for the period from 1 January 1977 to 3 May 2002 employing Generalized Autoregressive Conditional Heterocedastic (GARCH) model that is developed by Bollerslev (1986). Empirical outcomes show that KLSE is predictable and thus is not informationally efficient and volatility of composite index return is quite persistent.

In his Paper, Moustafa (2004) employes serial correlations and runs tests to examine the behavior of stock prices using data of the daily prices of 43 stocks included in the UAE market index covering the period from October 2, 2001 to September 1, 2003. The results reveal that the returns of 40 stocks out of the 43 are random at 5 percent level of significance, indicating that the UAE stock market follows weak-form efficiency of EMH.

Gunasekarage, Pisedtasalasai and Power (2004) examine the influence of macroeconomic variables on stock market equity values in Sri Lanka. The study uses the Colombo all share price index to represent the stock market, and the money supply, the treasury bill rate (as a measure of interest rates), the consumer price index (as a measure of inflation), and the exchange rate as macroeconomic variables for the monthly data of the 17 years period from January 1985 to December 2001 employing unit roots, cointegration, vector error correction models (VECM), impulse response functions (IRFs) and variance decompositions (VDCs). The VEC model provides that the lagged values of macroeconomic variables such as the consumer price index, the

money supply and the treasury bill rate have significant influence on the stock market. However, the stock index does not have any influence on macroeconomic variables except for the treasury bill rate.

Hameed and Ashraf (2006) test weak-form efficiency and conditional volatility of stock returns using daily closing values of the KSE-100 over the period from December 1998 to March 2006. ARMA (1, 1) and GARCH (1, 1)-M model are operated to model volatility and test for weak-form efficiency of the stock returns. The results reject weak-form efficiency hypothesis, and stock returns exhibit persistence and volatility clustering. The study also reveals that Pakistani stock market investors do not reward for taking increased risk as mean variance hypothesis does not hold.

Mehrara (2006) examines the causal relationship between stock prices (Tehran Exchange Price Index-TEPIX Index) and macroeconomic variables (money supply, value of trade balance, and industrial production) operating the techniques of the long-run Granger non-causality test proposed by Toda and Yamamoto (1995). The study reveals that macroeconomic variables are Granger-caused stock prices, while no reverse causality are noticed. The researcher then comments that stock price index is not a leading indicator and thus Iran stock market does not have informational efficiency at least with respect to money supply, trade balance and industrial production.

Gupta and Basu (2007) observe daily returns using daily index values for the Bombay Stock Exchange (BSE) and National Stock Exchange (NSE) of India over the period from 1991 to 2006 to find the weak form of efficiency. By means of three unit root tests named ADF, PP and KPSS, the study reveals that National Stock Exchange and Bombay Stock Exchange are not weak form efficient.

Lagoarde-Segot and Lucey (2008) investigate informational efficiency using daily data ranging from 1 January 1998 to 16 November 2004 of seven MENA stock market price indices from Morocco, Tunisia, Egypt, Lebanon, Jordan, Turkey and Israel. The research suggests that the MENA markets are predictable. Turkey and Israel exhibit the strongest evidence of weak-form efficiency. These markets are followed by Jordan, Tunisia, and Egypt, with Lebanon and Morocco lagging behind. The results also



suggest that the extent of weak-form efficiency in the MENA stock markets is principally defended by differences in stock market size. Corporate governance factors also have explanatory power, whereas the role of economic liberalization does not appear significant.

Sharma and Mahendru (2009) examine the validity of the Efficient Market Hypothesis on the Indian Securities Market taking a sample of eleven securities listed on the Bombay Stock Exchange (BSE) for the period from June 30, 2007 to October 27, 2007. By applying the runs tests and the autocorrelation tests, the results show that the BSE is weak form efficient as investors cannot gain extra profits by using the share price data because the current share prices reflect the past share prices.

Peng et al. (2009) analyze the relationship between GDP and stock prices (Composite Index for the Shanghai Stock Exchange) of China using monthly data from January 1992 to April 2008. VECM results show that there is a strong indication of long run causality. Results show that a modest but weaker short run causality is running from the economy to the stock market, but not vice versa. IRFs outcome shows a stronger and substantial effect from the economy to the stock market, while a small and weak link from the stock market to the economy.

Pilinkus and Boguslauskas (2009) make an effort to define what macroeconomic variables have positive and what macroeconomic variables have negative effects on stock market prices in Lithuania in the short run using six macroeconomic variables (seasonally adjusted gross domestic product at previous year prices, harmonized consumer price index as compared to 2005, the narrow money supply, unemployment rate, short-term interest rates, and exchange rate of the Litas against the US dollar) and the main Lithuanian stock market index – the OMX Vilnius index from the January of 2000 to the June of 2009. Unit root tests and impulse response function suggest that macroeconomic variables are significant determinants of stock market prices in Lithuania. GDP and money supply have positive effect on stock market prices; while, most of the time, unemployment rate, exchange rate and short-term interest rates negatively influence stock market prices.

Ali et al. (2010) examine the causal relationship between macroeconomic indicators (inflation, exchange rate, balances of trade, and index of industrial production) and stock market prices (the general price index of the Karachi Stock Exchange) in Pakistan using June 1990 to December 2008 data. Operating unit root test, Johansen's co-integration and Granger's causality test, they find that industrial production index and stock exchange prices are cointegrated, however, there are no causal relationship between macroeconomic indicators and stock prices in Pakistan.

Applying Johansen multivariate cointegration test and VECM, Srivastava (2010) investigates the relevance of macroeconomic factors for the Indian stock market. BSE SENSEX index is used as the dependent variable in against of four domestic macroeconomic (industrial production, wholesale price index, interest rate and foreign exchange rate) and one global (MSCI) explanatory variables. The study reports that IPI, WPI and IR are relatively more significant to influence the Indian stock market in LR, while ER and MSCI have little importance. He therefore concludes that the Indian stock market is more motivated by domestic macroeconomic factors rather than global factors in the long run.

Alzahrani (2010) examines whether stocks in the Saudi market exhibit a predictable return pattern around 2,170 quarterly earnings announcements covering the period between Q1 in 2001 and Q1 in 2009. The event study technique uses OLS regression method, and results report that rational, risk-averse investors underreact to positive news, and overreact to negative news. He finds that earnings announcement return can be a good predictor for subsequent returns or drift in the market for the following four weeks. The study also finds that relative trading volume (turnover) is a another good explanatory for future returns.

Khan and Ikram (2010) examine the semi- strong form of efficiency of national stock exchange and Bombay stock exchange of Indian capital market in relation to the impact of foreign institutional investors over the period 1 April 2000 to 30 April 2010. Karl-Pearson's Product Moment Correlation Coefficient (Simple Correlation) and linear regression equations are used to reach the conclusion that the Indian capital market is

semi-strong form efficient as there is no significant impact of foreign institutional investors' investment on Indian capital market.

Employing GARCH methodologies, Li, Hamill, and Opong (2010) analyze the stylized facts of daily data for the Africa All-Share (ex South Africa) Index and its constituent size indices: Africa Large Company Index (ABRL), Africa Medium Company Index (ABRM), and the Africa Small Company Index (ABRS) from 1 January 1999 to 22 February 2008. The return distributions of all indices are found to be leptokurtotic, have fat-tails, overtime experienced volatility clustering and exhibit long memory in volatility. Both the All-Share and Large Company Indices exhibit leverage effects, while positive shocks have a greater impact on future volatility for the Small Company Index which implies a reverse leverage effect. So the results for the All-Share, Medium, and Large Company Indices are broadly consistent with the stylized facts.

Sharma and Mahendru (2010) conduct a study on the impact of four macroeconomic variables such as Gold Price (GP), Foreign Excess Reserves (FER), Exchange Rates, and Inflation rate on BSE prices of India using weekly data from January 2008 to January 2009. By employing multiple regression analysis, the study reveals that BSE prices have entirely affected by GP and ER, while FER and INF have no influence on it.

Oskooe (2011) investigates the weak form efficiency using the daily stock price index of Iran stock market (TEPIX) including 2632 observations during the period January 2, 1999 to December 30, 2009. The paper implements a new nonlinear Fourier unit root test and the empirical results recommend that even in the presence of nonlinearity and unknown structural breaks, the Iran stock prices index follows random walk hypothesis and is efficient in weak form.

Adaramola (2011) explores the impact of six macroeconomic indicators (money supply, interest rate, exchange rate, inflation rate, oil price, and gross domestic product) on 36 (out of 93) firm's individual stock prices in Nigeria using quarterly data from 1985:Q1 to 2009:Q4. The pooled or panel model is used to combine both time series and cross-sectional data. The empirical findings of the Generalized Least

Square (GLS) method uncover that the macroeconomic variables (except INF and MS) fluctuating have significant impacts on individual firm's stock prices in Nigeria. He therefore concludes that trends in macroeconomic variables to be able to predict movement of stock prices to a great extent in Nigeria.

Applying Full Information Maximum Likelihood (FIML) estimation procedure, Kuwornu and Owusu-Nantwi (2011) examine the relationship between macroeconomic variables and stock market returns in Ghana using monthly data over period January 1992 to December, 2008. Macroeconomic variables used in this study are consumer price index (as a proxy for inflation), crude oil price, exchange rate, and 91 day Treasury bill rate (as a proxy for interest rate). The empirical results reveal that CPI (Inflation rate) has a significant positive relationship, while exchange rate and Treasury bill rate have negative significant influence on stock returns. However, crude oil prices do not seem to have any significant effect on stock returns in Ghana.

Herve, Chanmalai and Shen (2011) investigate the role of macroeconomic variables (IPI, CPI, IR, ER and M2) on stock prices movement in Cote d'Ivoire (West African Monetary Union-BRVM 10 Index ) with quarterly data covering the period of 1999:Q1 to 2007:Q4 using Johansen's multivariate cointegration test, IRF, FEVD and Granger causality techniques. They test both long-run and short-run dynamic relationships between the stock market index and the economic variables. The study shows that there is cointegration between macroeconomic variables and stock prices in Cote D'Ivoire specifying long-run relationship. The results of Impulse Response Function (IRF) and Forecast Error Variance Decomposition (FEVD) show that consumer price index and domestic interest rate are the key determinants of the stock price movements in Cote d'Ivoire. The Granger-causality test based on the vector autoregression (VAR) reveals that there is a strong bi-directional relationship between stock price index and domestic interest rate IR in Cote d'Ivoire.

Oseni and Nwosa (2011) examine the relationship between the stock market volatility and volatility in macroeconomic variables such as real GDP, inflation, and interest rate for the periods from 1986 to 2010 in Nigeria. By means of AR (k)-EGARCH (p, q) and

LA-VAR Granger Causality test, the analysis suggests that there is a bi-directional causal relationship between stock market volatility and real GDP volatility, while no causal relationship between interest rate and inflation volatility, and stock market volatility is found.

Ashikh (2012) investigates the existence of the random walk hypothesis by testing the weak-form efficiency along with the existence of the day-of-the-week effects in the returns of the Saudi Stock Exchange (SSE), using parametric and nonparametric linear serial dependence tests. The results indicate that the Saudi Stock Exchange (SSE) returns exhibit significant linear serial dependence. Thus, the Saudi Stock Exchange is inefficient in the weak-form of the EMH. The results also show evidence of day-of-the-week effects in the Saudi Stock Exchange, both in mean (returns) and variance (volatility) equations.

Zakaria and Shamsuddin (2012) inspect the relationship between stock market returns volatility in Malaysia with five selected macroeconomic volatilities (IPI proxy for GDP, CPI proxy for INF, ER, IR, and M2 proxy for MS) based on monthly data from January 2000 to June 2012 using GARCH (1, 1) models and bi-variate, and multivariate VAR Granger causality tests along with regression analysis. The results from bi-variate VAR Granger causality tests show that volatility in CPI and IR are significantly Granger - caused the volatility in stock market returns. The result from both tests reveal that the volatilities of macroeconomic variables as a group does not Granger cause volatility in stock market returns. The result from regression analysis shows that money supply volatility is significantly related to stock market volatility.

Elshareif, Tan and Wong (2012) analyze the behavior of Malaysian stock market and the impact of unexpected volatility shifts in terms of its efficiency and returns, during the past two decades using weekly closing stock price index of Kuala Lumpur Composite Index (KLCI), plantation (PLT), Properties (PROP), Industrial (IND), and Finance (FIN) from June 1990 to June 2011. The study employes EGARCH-M Model and the results reveal that KLCI and the Industrial sector index are most inefficient. Additionally, this study also finds that all sectors of the stock market are more sensitive to global news events as compare to the local news, and the

asymmetrical responses to good and bad news are an important characteristic of the Malaysian market behavior.

Elbarghouthi, Yassin and Qasim (2012) investigate the EMH for the daily prices of the five indices of Amman Stock Exchange from 1 January 2000 to 31 December 2008. The Box-Jenkins estimation implies the existence of deviations from market efficiency, and the unit-root test confirms that the return series for all indices do not exhibit unit root. Even though, the price series for the general, bank and insurance indices exhibit unit roots, it is not sufficient for a random walk process since the series do not fit the ARIMA (0, 1, 0) model.

Nikita and Soekarn (2012) test the Weak Form Efficient Market Hypothesis in Indonesia's Stock Market using daily closing price of IHSG and LQ45 composite index between four years period (2008-2011). The autocorrelation, run test and a regression analysis are used to prove the signs of weak form market efficiency. The result displays the existence of non-randomness behavior and significant autocorrelation on IHSG and LQ45 index. Furthermore, the relationship between variables in the regression equation of both indices exhibits significant result. Finally, they conclude that Indonesia Stock Market is not efficient in weak form during the sample period.

Gimba (2012) tests the Weak-form efficient market hypothesis of the Nigerian stock exchange by All Share Index, and five most traded and oldest bank stocks of the NSE from January 2007 to December 2009 for the daily data and from June 2005 to December, 2009 for the weekly data. The empirical outcomes derive from the autocorrelation tests, run tests and variance ratio tests for the observed returns conclusively settle that the NSE stock market is inefficient in the weak form.

Oke and Azeez (2012) test whether the Nigerian capital market follows strong-form efficiency employing the Autoregressive Conditional Heteroscedascity (ARCH) and Generalized Autoregressive Conditional Heteroscedascity (GARCH) models for the period from 1986 to 2010. The study submits two models such as  $MC=f(GDS, VT, ASI)$  and  $ASI=f(GDS, MC, VT)$ , where MC=Market Capitalization, GDS=Government Development Stock, VT=Value of transaction at the stock

exchange, and ASI=All Share Index. The findings reveal that the Nigerian capital market is weak-form efficient and strong-form inefficient.

Naik and Padhi (2012) investigate the relationships between the Indian stock market index (BSE Sensex) and five macroeconomic variables, namely, industrial production index, wholesale price index, money supply, treasury bills rates and exchange rates over the period from 1994:04–2011:06 employing Johansen's cointegration, VECM and Granger causality test. The study states that a long-run equilibrium relationship exists between macroeconomic variables and the stock market index. It is detected that money supply and industrial production are positively related, but inflation is negatively related to stock prices, while exchange rate and treasury bills rate are appeared insignificant. The results of Granger causality show that macroeconomic variables cause the stock prices in the long-run but not in the short-run.

Kenani et al. (2012) examine the short and long run dynamic linkages between stock prices and exchange rates taking into consideration the internal and external macroeconomic structural shocks (interest rate changes and South African stock prices) on the Malawi stock market and foreign exchange market using January 1999 to January 2010 monthly data of Malawi stock exchange indices (MSE), average nominal exchange rate, real interest rate, and Johannesburg Stock Exchange (JSE) share price index. The cointegration results display that there is no cointegration relationship indicating that the variables have no long-term relationship. The results also indicate that internal and external macroeconomics shocks do not have instantaneous effect on the stock market and foreign exchange market. They conclude that domestic policy decisions should not be seriously influenced by activities of world financial markets as these two markets are not deeply integrated with world financial markets.

Sabunwala (2012) resolves the relationship between the real economic variables and the index of the Bombay stock exchange (BSE) employing multiple regression model. She considers monthly data between 1994 and 2010 of several economic variables like IPI as the proxy of national output, fiscal deficit, interest rate, inflation, exchange rate,

foreign institutional investment (FII). The finding shows that domestic inflation and exchange rate are two important factors influencing stock prices.

Employing multiple regression model and Granger causality test, Ray (2012) explores the impact of 13 macroeconomic variables on the stock prices in India (BSE SENSEX) using annual data from 1990-91 to 2010-11. The macroeconomic variables are balance of trade (BoT), call money rate (CMR) as proxy for interest rate, consumer price index as proxy for inflation (CPI), foreign direct investment (FDI), foreign exchange reserve (FER), gross domestic product (GDP), gross fixed capita formation (GFCF), gold price (GP), industrial production index (IPI), broad money supply (M3), crude oil prices (OP), exchange rate (ER), wholesale index of prices (WPI). The multiple regression outcomes show that oil price and gold price have a significant negative effect, while balance of trade, call money rate (IR), foreign exchange reserve, gross domestic product, industrial production index and money supply have a positive influence on stock prices of India. Granger causality test indicates that stock prices have no causal association with interest rate and index of industrial production, but unidirectional causality exists with (CPI) inflation, foreign direct investment, gross domestic product, exchange rate and gross fixed capital formation; nevertheless bi- directional causality exists with foreign exchange reserve, money supply, crude oil price and wholesale price index.

Employing cointegration and ECM techniques for yearly data from 1975 to 2005, Osamwonyi and Evbayiro-Osagi (2012) determine the SR and LR relationship between macroeconomic variables (IR, INF, FD, ER, MS, GDP) and the Nigerian capital market index. The major finding is that macroeconomic variables influence stock market index in Nigeria, though GDP and CPI (INF) are two variables that positively related with stock market prices in both the SR and LR.

Hsing, Budden and Phillips (2012) examine the macroeconomic determinants of the stock market index of Argentina employing exponential GARCH model for the quarterly sample during 1998.Q1-2011.Q2. They obtain that the Argentine stock market index is positively associated with real GDP, the ratio of M2 to GDP, the peso/USD exchange rate and the U.S. stock market index S& P 500. It is negatively influenced by



the money market rate (IR), government spending as a percent of GDP and the inflation rate.

Kisaka and Mwasaru (2012) examine the causal relationship between foreign exchange rates and stock prices in the Nairobi Securities Exchange of Kenya from November 1993 to May 1999 using cointegration and ECM techniques. The empirical results show that the variables are cointegrated. They use error-correction models instead of the classical Granger-causality tests since the variables are cointegrated. The empirical results of ECM indicate that exchange rates Granger-cause stock prices in Kenya and there is unidirectional causality from exchange rates to stock prices.

Eita (2012) investigates the macroeconomic determinants of stock market prices in Namibia using Johansen's Cointegration test and Impulse Response methods using quarterly data of the period 1998:Q1 to 2009:Q4. The study shows that Namibian stock market prices are primarily determined by economic activity (real GDP), interest rates, inflation, money supply, and exchange rates. He comments that an increase in real GDP and MS increases stock market prices, while increases in inflation and interest rates decrease stock prices. Disequilibrium in stock market prices in Namibia is adjusted in the course of correction in the stock market price itself.

Singh, Tripathi and Lalwani (2012) examine the impact of exchange rate and inflation rate on the performance of Bombay Stock Exchange (BSE) in India for the period of April 2007 to March 2012. The Linear Regression Analysis results suggest that inflation rate and exchange rate significantly affect the performance of BSE Sensex.

Xiao and Kong (2012) investigate the relationship between turnover rate and stock returns in Chinese stock market (Shanghai Stock Exchange) with monthly data from 2009 to 2012 employing Granger causality analysis and VAR model. The result indicates that turnover rate has minor influence on stock returns, while stock returns has large positive influence on the turnover rate.

Adu et al. (2013) examine the effect of macroeconomic factors (exchange rate, rate of inflation, interest rate, and M2) on stock market performance (All-share index in Ghana

Stock Exchange) employing a local-linear non-parametric kernel regression technique. The study shows that the stock prices are significantly affected by macroeconomic fundamentals.

Jain (2013) finds the relationship between SENSEX and selected macroeconomic variables, i.e., exchange rate, inflation and FII (Foreign Institutional Investment) in India for a period of 5 years from 2008-09 to 2012-14. Results of Pearson correlation and regression analysis provide a strong positive significant relationship between SENSEX and FII, and strong negative relationship between SENSEX and Exchange rate.

Vejzagic and Zarafat (2013) examine the long-term equilibrium relationship between selected macroeconomic variables (interest rate, money supply M2, consumer price index, and exchange rate) and the FTSE Bursa Malaysia Hijrah Shariah Index using monthly observations of September 2006 to September 2012. Employing cointegration test, VECM, VDCs and IRF model, they conclude that FTSE Bursa Malaysia Hijrah Shariah Index plays an important role in the economy as it influences and lead major macroeconomic variables. The study shows that there is a negative significant relationship between interest rates, exchange rate, and stock index, while positive significant relationship with money supply.

Using monthly data, Naik (2013) studies the impact of five macroeconomic variables, namely, industrial production index, inflation (WPI), money supply (M4), short term interest rate (TB), exchange rates on BSE index over the period 1994:04 –2011:04. Johansen's co-integration and vector error correction model are employed to explore the long-run equilibrium relationship and reveal that macroeconomic variables and the stock market index are cointegrated. Therefore, a long-run equilibrium relationship exists between them. The study also reveals that the stock prices are positively related to money supply and industrial production and negatively related to inflation, while exchange rate and the short-term interest rate are insignificant in determining stock prices. In the Granger causality viewpoint, macroeconomic variable causes the stock prices in the long-run as well as in the short-run.

El-Nader and Alraimony (2013) research the association between the Amman Stock Exchange (ASE) development and macroeconomic variables of the Jordanian economy over the period 1990-2011 using monthly data. The study uses stock market capitalization relative to GDP as dependent variable, while explanatory variables are nominal gross domestic product, money supply to GDP, total value traded relative to GDP (measures stock market liquidity), gross capital formation relative to GDP (measures investment), net remittances relative to GDP, consumer price index (measures macroeconomic stability) and credit to private sector relative to GDP. Multivariate cointegration and variance decomposition analysis are employed to examine the impact of these variables. The estimated findings demonstrate that the variables, namely, money supply relative to GDP, total value traded relative to GDP, gross capital formation relative to GDP, Consumer Price Index (CPI), and credit to private sector relative to GDP have positive and significant influences on stock market development. In contrast, nominal Gross Domestic Product and net remittances relative to GDP have negative impacts. The Johansen and Juselius' multivariate cointegration and variance decompositions analysis confirm the presence of both a long-term and short-term dynamic relationship between the Stock market capitalization relative to GDP and macroeconomic variables. In the light of these results, the paper provides some policy implications to Jordan.

Asiri and Alzeera (2013) test the weak-form market efficiency in Saudi Arabia's stock market using all share index and sectoral indices for daily closing prices between October 15, 2006 and November 15, 2012. Dickey-Fuller test, Pearson Correlation test, Durbin-Watson test, and Wald-Wolfowitz runs-test show the weak-form market efficiency in the Saudi stock market for all share prices and 11 individual sectors.

Employing Lo and MacKinlay's methodology, Nguyen, Islam and Ali (2014) examine random walk model on the weekly movements of equity indices in Malaysia, the Philippines and Taiwan over the period from the first week of 2000 to the second week of 2012. The results suggest that the equity markets in these Asian countries follow a random walk over the sample period.

Omar et al. (2013) examine the random walk behavior in the Karachi Stock Exchange using daily, weekly, and monthly stock returns of KSE 100 index for the period from 1 January 1998 to 29 February 2012 applying VAR test, RUN test, KS test and unit root tests (ADF test and PP). Results of all the tests specify that the KSE does not follow random walk behavior and therefore, the KSE is not weak form efficient. They conclude that there are chances of abnormal profit for the technical investors in the Pakistan stock market.

Hou (2013) examines the return volatility and the asymmetric effect of market news on the volatility in the Chinese stock markets using a generalized additive nonparametric approach. With respect to the predicted return volatility's asymmetric reaction to good news and bad news, the empirical results indicate that the return volatility responds more strongly to bad news in the daily closing prices of the two primary Chinese indices, the Shanghai Stock Exchange Composite Index (SHCI) and the Shenzhen Stock Exchange Component Index (SZCI) from January 2, 1997 to August 31, 2007. So, an asymmetric effect of negative news exists in the Chinese stock markets.

Employing serial correlation, ADF, run test and regression analysis techniques, Alkhatib and Harasheh (2014) empirically examine the random walk theory of the weak-form market efficiency using past returns of the seven indices of Palestine Exchange (PEX). The results of the analysis show that stock indices of PEX do not support the random walk model.

#### **4.4 Studies Related to Multiple Countries**

Mougoué and Whyte (1996) examine the relationship between stock returns and volatility in the German and French equity markets for the period from December 31, 1979 to July 7, 1991 employing GARCH model proposed by Bollerslev (1986). The results indicate that stock returns in both countries may be described by the GARCH (1, 1) model. They also reveal that the index of relative risk aversion is positive in both countries but, it is only significant in Germany when the 1987 U.S stock market crash is incorporated into the analysis.

Gunasekarage and Power (2001) analyze the performance of technical trading rules (moving average rules) using index data from 1 January 1990 to 31 March 2000 for four emerging South Asian capital markets, namely the Bombay Stock Exchange, the Colombo Stock Exchange, the Dhaka Stock Exchange and the Karachi Stock Exchange, and examine the implications of the results for the weak form of the efficient market hypothesis. The results suggest that the equity returns in these markets are predictable.

Fernández-Izquierdo and Lafuente (2004) examine the dynamic linkages between international stock market volatility during the Asian crisis in 12 relevant stock exchanges at an international level. Using daily closing stock market indices from 7 January 1997 to 28 December 2001 of Argentina, Chile, Germany, Hong Kong, Italy, Japan, Mexico, Singapore, South Korea, Spain, United Kingdom and the United States, the study focuses on the contagion hypothesis around the world. The study reveals that significant leverage effects are due not only to negative shocks in the market area itself, but also to foreign negative shocks.

Chang, Lima and Tabak (2004) test whether returns of daily closing stock prices of Argentina, Brazil, Chile, India, Indonesia, Malaysia, Mexico, the Philippines, South Korea, Taiwan, Thailand, Japan and the US are predictable applying multivariate variance ratios using heteroscedastic robust bootstrap procedures. Empirical results suggest that emerging equity indices do not follow random walk while developed country indices (US and Japan) follow random walk.

Basher and Sadorsky (2006) investigate the relationship between oil price movements and stock returns in 21 emerging stock markets using an international multi-factor model that allows for both unconditional and conditional risk factors. The data for this study consists of daily closing prices of Argentina, Brazil, Chile, Colombia, India, Indonesia, Israel, Jordan, Korea, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, South Africa, Sri Lanka, Taiwan, Thailand, Turkey and Venezuela stock markets over the period December 31, 1992 to October 31, 2005. The results reveal that oil price risk plays an important role in pricing emerging market stock returns. They show that oil price risk is positive and statistically significant at the 10% level in most models.

Nikkinen et al. (2006) investigate global stock market reactions to scheduled U.S macroeconomic news announcements using stock market indices of 35 countries from the period July 1995 to March 2002. To investigate this issue they analyze the behavior of GARCH volatilities around ten important scheduled U.S macroeconomic news announcements (consumer confidence, consumer price index, employment cost index, employment situation, gross domestic product, import and export price indices, manufacturing and non-manufacturing, producer price index and retail sales) on 35 local stock markets that are divided into six regions countries such as the G7 countries, the European countries other than G7 countries, developed Asian countries, emerging Asian countries, Latin American countries and countries from Transition economies. The results show that the G7 countries, the European countries other than G7 countries, developed Asian countries and emerging Asian countries are closely integrated with respect to the U.S macroeconomic news, while Latin America and Transition economies are not affected by U.S news.

Cooray and Wickramasighe (2007) examine the weak form and semi-strong form of EMH in the stock markets of India, Sri Lanka, Pakistan, and Bangladesh by employing unit root tests, cointegration and Granger causality tests for the monthly data of the period January 1996 to January 2005. Using the FTSE index for India and Pakistan, the All Share Index for Sri Lanka and the S&P for Bangladesh, the unit root tests support weak form efficiency in all four countries while the DF-GLS and ERS tests do not support weak form efficiency for Bangladesh. The study also reveals that stock price shocks in India have a greater effect on the stock market of Pakistan than those of Sri Lanka and Bangladesh, although the semi-strong form of EMH is not supported by the markets. Nevertheless, the results of the Granger causality tests indicate that the markets follow the semi-strong version of the efficient market hypothesis in the short-run.

Borges (2008) tests weak form of EMH of the six European stock markets named France, Germany, UK, Greece, Portugal and Spain using daily and monthly data for the period of 1993 to 2007 and 2003 to 2007. He uses serial correlation test, runs test, augmented Dickey-Fuller test, and the multiple variance ratio tests, and concludes that monthly stock prices and returns follow random walks in all six countries, while France,

Germany, UK and Spain meet up most of the conditions for a random walk behavior with daily data. However, Greece and Portugal have experienced a serial positive correlation for the period of 1993 to 2007, while these two countries have also been approaching a random walk behavior after 2003.

Alam and Uddin (2009) assess the presence of share market efficiency based on the monthly data of fifteen countries from January 1988 to March 2003, and reveal the empirical relationship between stock index and interest rate for developed (Australia, Canada, Germany, Italy, Japan, South Africa, Spain) and developing countries (Bangladesh, Chile, Colombia, Jamaica, Malaysia, Mexico, Philippine, Venezuela). This paper examines the random walk theory of the weak form efficiency that assumes consecutive price changes are independent. The random walk theory is violated for all countries' Stock Exchange and implies these markets are not efficient in weak form. To inspect the causes of market inefficiency, they further investigate the aspect of relationship between share price and interest rate, and changes of share price with changes of interest rate. OLS method results that interest rate has significant negative relationship with share price for all of the countries and changes of interest rate has significant negative relationship with changes of share price for six countries (Japan, Malaysia, Bangladesh, Colombia, Italy and South Africa).

Rahman and Uddin (2009) inspect the connections between stock prices and exchange rates in three emerging countries of South Asia named as Bangladesh, India, and Pakistan. They take into account average monthly nominal exchange rates of US dollar in terms of Bangladesh Taka, Indian Rupee, and Pakistani Rupee, and monthly values of Dhaka Stock Exchange General Index, Bombay Stock Exchange Index, Karachi Stock Exchange All Share Price Index for period of January 2003 to June 2008. Empirical results of Johansen cointegration analysis show that there is no cointegrating relationship between stock prices and exchange rates. Finally, they employ Granger causality test, and show that there is no way causal relationship between stock prices and exchange rates in the countries.

Bley (2011) examines the weak-form efficiency in the stock markets of the Gulf Cooperation Council using daily, weekly, and monthly index data for the 10-year period

2000–2009. The analysis is performed for the full 10-year and two 5-year sub-periods. The results reject the hypothesis of a random walk for every single country market on the basis of daily data. On the basis of weekly and especially monthly data, a random walk seems to present in Bahrain, Qatar and Saudi Arabia in individual sub periods.

Apergis, Artikis and Eleftheriou (2011) analyze the dynamic relationship between excess returns and macroeconomic factors for a group of emerging markets such as Argentina, Brazil, Chile, Czech, Egypt, India, Indonesia, Israel, Malaysia, Mexico, Pakistan, Peru, Philippines, Thailand, South Africa and Venezuela over the period 1996-2009 (quarterly data) using the panel GMM estimator methodology suggested by Arellano and Bond (1991). A number of manufacturing firms are used from each country along with their stock prices in against of the macroeconomic factors, such as GDP, the consumer price index, M1, the short-term interest rate, the trade deficit, and the government deficit as a percentage of the country's GDP. The empirical findings indicate that a number of macroeconomic factors play a significant role in explaining excess returns in the emerging markets.

Barbic and Condic-Jurkic (2011) test for the existence of informational inefficiencies on stock markets of selected CEE countries (Croatia, Czech Republic, Hungary, Poland and Slovenia) examining the relationship between stock market indices and macroeconomic variables such as inflation rate, broad money supply, money market interest rate and foreign currency reserves employing Johansen cointegration method and Granger causality test. Using monthly data for the period from January 1998 to January 2010, the study shows that there is a long run relationship between stock market indices and macroeconomic variables in case of Poland and Czech Republic, while the most noticeable predictor of the long run developments on Croatian and Hungarian stock market is interest rate. The results of Granger (non) causality expose that there is no causal linkage between any macroeconomic variable and stock market index in Croatia, Hungary and Poland indicating that Croatia, Hungary and Poland markets could be apparent efficient in the short run.

Walid et al. (2011) investigate the impact of foreign exchange rate changes on stock market volatility using weekly data from December 1994 to March 2009 for four



markets such as Hong Kong, Singapore, Malaysia, and Mexico based on a two regime Markov switching-EGARCH model. The results support robust evidence of regime switching behavior in volatility on the stock markets and expose the incidence of two volatility regimes. High mean-low variance regime tends to dominate for all countries, while low mean-high variance regime seems less dominant. Periods of high volatility in all four stock markets coincide with several economic and political events such as Mexican currency crisis, Asian financial crisis, the terrorist attacks of 2001 and the US subprime crisis of 2008. The study reveals that there is a dynamic relationship between foreign exchange rate changes and stock market behavior, while the relationship is regime dependent and stock price volatility responds asymmetrically to events in the foreign exchange market.

Laopodis (2011) addresses the dynamic linkages between stock prices and economic fundamentals (economic activity, short-term interest rates, and consumer price indexes) for the period 1990–2009 for France, Germany, Italy, the UK and the US using the rolling-sample cointegration technique and VAR specifications. The empirical analysis is done splitting the sample into pre-Euro, 1990:1–1998:12, and post-Euro, 1999:1–2009:12, sub periods. The results show that the stock prices are not influenced much by industrial production or interest rates, and the impacts of retail trade and crude oil prices on stock prices are smaller in the post- than in the pre-Euro period. However, the US's stock market is an exception which is more sensitive to crude oil shocks.

A number of recent studies have found a link between oil price changes and stock prices. In this regard, Mohanty et al. (2011) assess the relation between changes in crude oil prices and equity returns in Gulf Cooperation Council (GCC) countries using country-level as well as industry-level stock return data. The study provides evidence that oil price changes have asymmetric effects on stock market returns at the country level as well as at the industry level.

Patel, Radadia and Dhawan (2012) investigate the weak form of market efficiency of Asian four selected stock markets (namely Bombay Stock Exchange, Hong Kong Stock Exchange, Tokyo Stock Exchange and Shanghai Stock Exchange) using daily closing price of stock markets from the 1 January 2000 to 31 March 2011 and also splitting full

sample in three interval periods. Employing various test like Runs Test, Unit Root Test, Variance Ratio and Auto Correlation, the overall results imply that the stock markets under study are weak-form inefficient.

Tsai (2012) estimates the relationship between stock price index and exchange rate using the monthly data of Singapore, Thailand, Malaysia, the Philippines, South Korea, and Taiwan from January 1992 to December 2009 employing the quantile regression model. The empirical results show that the data in all six Asian countries have a similar pattern in the various coefficients obtained from different quantile functions. The coefficients are more significantly negative when the exchange rates are extremely high or low.

Nisar and Hanif (2012) examine the weak form of EMH on the four South Asian countries named India, Pakistan, Bangladesh and Sri Lanka including daily, weekly and monthly data of KSE-100, BSE-SENSEX, CSE-MPI and DSE-GEN basis for a period of 14 Years (1997-2011). Based on runs test, serial correlation, Durbin Watson test, unit root and variance ratio test, the study reveals that all these markets do not follow random walk hypothesis of weak form efficiency. However, the results of run test imply that weekly and monthly return of DSE and BSE, along with monthly return of KSE follow the weak form of EMH, while daily return of the markets do not follow random walk hypothesis of EMH.

Rahman and Uddin (2012) investigate the weak form of EMH of three South Asian stock markets named DSE, BSE and KSE from Bangladesh, India and Pakistan respectively. The study uses monthly closing values of stock indices for a period of January 2000 to June 2010. Based on autocorrelation, unit root, cointegration and Granger causality test, the study rejects random walk hypothesis for all the three markets which evidence that the markets are not weak forms of efficient. Furthermore, the study reveals that the three South Asian stock markets are cointegrated.

Mishra (2012) accomplishes to test the weak form efficiency of selected South Asian capital markets (India, Sri Lanka, Pakistan, Bangladesh and Mauritius) over the sample period from January 2005 to October 2010. The study uses ADF and PP unit root tests

to examine the efficient market hypothesis for South Asia capital markets. The results provide the evidence that the selected South Asia stock markets are not weak form efficient as there is a scope for profitable trading.

Forgha (2012) gives an empirical evidence of the efficiency and volatility of stock returns in five stock markets in Africa, namely, Cameroon, Nigeria, South Africa, Egypt and Kenya employing Generalized Autoregressive Conditional Heteroskedasticity Mean (GARCH-M), ADF and the Variance Ratio tests for the quarterly data from 2001 to 2010. The results show that the markets are inefficient as the random walk hypothesis is rejected. He argues that volatility of stock returns should not be viewed as constraints, but as one of the risks of investment as where there is high risk of investment, there is also high returns.

Aurangzeb (2012) identifies the factors (interest rate, inflation, exchange rate and foreign direct investment) affecting the performance of the stock market in South Asian countries, namely, Pakistan (KSE-100), India (BSE-30) and Sri Lanka (All share price index, CSE) from the period of 1997 to 2010 employing multiple regression analysis. Regression results indicate that FDI and ER have significant positive impact, while IR has significant negative impact and INF has negative, but insignificant impact on the performance of stock market in South Asian countries. He recommends that governments may reduce the interest rates and inflation rate as much as possible in order to take the full advantage of stock market. He also observes that some extra benefits are given to the foreign investors because the influence of foreign investors is strong in this region.

Masuduzzaman (2012) investigates the long-run relationship and the short-run dynamics among macroeconomic variables and the stock returns of Germany and the United Kingdom using consumer price index, interest rates, exchange rates, money supply and industrial productions for the period from February 1999 to January 2011. He applies Johansen co-integration, error correction model, variance decomposition, impulse response functions and shows that all the variables are cointegrated with stock prices in both markets. The study indicates that short and long run causal relationships

exist between stock prices and macroeconomic variables for both the UK and the German stock market returns.

Farsio and Fazel (2013) investigate the relationship between unemployment rate and stock prices in USA, China, and Japan using quarterly data over the 1970-2011 period. In this paper, Farsio and Fazel argue that the view of financial analysts is misleading to potential investors who assert that unemployment rate is a strong predictor of stock prices. Based on cointegration and Granger Causality tests, the study concludes that there is no stable long-term causal relationship from unemployment rate (UR) to stock prices.

Rizeanu and Zhang (2013) test correlations between the exchange rate returns and stock market returns for a sample of 21 MSCI Emerging Markets (Brazil, Chile, China, Colombia, the Czech Republic, Egypt, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Morocco, Peru, the Philippines, Poland, Russia, South Africa, Taiwan, Thailand and Turkey) and 2 newly industrialized countries (Hong Kong and Singapore) over the period 1994–2010. They find significant and positive correlations between the exchange rate returns and excess emerging stock market returns relative to the United States, indicating that positive shocks in emerging equity markets are associated with appreciation of the emerging market currencies.

Andreou, Matsia and Savvides (2013) investigate bi-directional linkages between the stock and foreign exchange markets of 12 emerging economies by employing a vector autoregressive model with Generalized Autoregressive Conditional Heteroskedasticity (VAR-GARCH). In order to compute stock market and exchange rate returns, they use weekly data from the Emerging Markets Database (EMDB) of Standard and Poor's that cover the period 06/01/1989 to 15/08/2008 for twelve emerging economies in Asia (India, Korea, Malaysia, Pakistan, Philippines and Thailand) and Latin America (Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela). The analysis shows that there is strong sign of bi-directional causality in variance between the foreign exchange market and stock market in all emerging economies but Colombia. Global and regional stock markets also postulate significantly to volatility spillovers. The study also reveals that the Asian crisis

significantly effects on the volatility transmission mechanism between the foreign exchange market and the emerging stock market in both directions.

Mensi et al. (2014) empirically examine the dependence structure between the BRICS stock markets and major global economic and financial factors over the daily period from September 29, 1997 to September 20, 2013 using the quantile regression approach. These global factors include: (i) the major global stock market represented by the S&P 500 stock returns, (ii) the WTI crude oil price expressed in U.S. dollars per barrel, which is a global benchmark for determining the prices of other light crudes in the United States, (iii) the gold price expressed in U.S. dollars per ounce, (iv) the implied volatility of the S&P 500 index as represented by the VIX index and (v) the U.S. economic policy uncertainty index. The results show that the BRICS stock markets reveal dependence with the global stock and commodity markets (S&P index, oil and gold) as well as changes in the U.S. stock market uncertainty. They comment that the dependence structure is often asymmetric and affected by the beginning of the recent global financial crisis.

Narayan, Narayan and Thuraisamy (2014) examine whether macroeconomic factors and institutional factors predict excess returns in the eighteen developing countries such as Argentina, Bangladesh, Brazil, Chile, China, Egypt, Kenya, Lebanon, Malaysia, Mexico, Oman, Pakistan, Peru, Russia, South Africa, Taiwan, Tunisia and Venezuela. The study includes equity market returns for 18 emerging markets, the Morgan Stanley Capital Index (MSCI) local currency world market index, and institutional and macroeconomic variables. They employ four institutional risk components, namely, corruption, ethnic tension, external conflict and law and order. In addition, they employ 10 macroeconomic risk components, namely, budget balance as a percentage of GDP, current account as a percentage of exports of goods and services (XGS), current account as a percentage of GDP, debt service as a percentage of XGS, exchange rate stability, foreign debt, GDP growth, inflation, net international liquidity and per capita GDP. The results of principal component analysis find that macroeconomic variables component predicts excess returns for seven countries (Bangladesh, Brazil, China, Argentina, Kenya, Oman and Venezuela), while the principal component of macro indicators is modelled with the world excess market return. It is also able to predict the excess

returns of Chile, China and Lebanon. Finally, the study also finds that the institutional risk components predict excess returns for seven countries (Argentina, Chile, Egypt, Kenya, Oman, Pakistan and Tunisia). It also predicts excess returns for Brazil, Chile, China, Malaysia, Peru and South Africa, while the principal components of institutions conjoin with the world market excess returns.

Blau, Brough and Thomas (2014) examine the link between economic freedom and related macroeconomic characteristics and the stability of security prices. Using a sample of 327 American Depositary Receipts (ADRs) which have underlying firms in 41 countries across the globe, they find an inverse relation between the economic freedom of a ADRs' home country and the price volatility of the ADR. They comment that this negative correlation is determined mainly by certain components of economic freedom, such as, property right protection, the soundness of the money and the level of free trade in the home country. Further, the study finds evidence that less regulation and less government control of markets in the home country lead to more stable ADR prices. In other tests, they examine the effect of other macro-level factors {GDP, FDI, official development assistance (ODA) and stock market volume} in the home countries of ADRs on price volatility and the results show that more corrupt countries, smaller economies and recipients of greater amounts of official development assistance have more volatile ADRs.

Tiwari and Kyophilavon (2014) examine the use of the random walk hypothesis on the BRICS stock indices using recently developed wavelet-based unit root test by Fan and Gençay (2010) along with a battery of unit root tests. Based on the monthly average stock indices of the stock markets of Brazil (Bovespa Index of São Paulo Stock, Mercantile & Futures Exchange), Russia (MICEX index of MICEX Stock exchange), India (SENSEX index of Bombay Stock exchange), China (SSE composite Index of Shanghai Stock Exchange) and South Africa (Johannesburg Stock Exchange (JSE)) for the period of January 2000 to December 2010, the unit root tests show evidence that except for the stock market in the Russian Federation, all of the other analyzed stock markets do not follow the random walk behavior during the period.

Broadstock and Filis (2014) examine the time-varying correlations between oil price shocks of different types (supply-side, aggregate demand and oil-market specific demand) and stock market returns from two countries, China and the US, using a Scalar BEKK model from 1995 to 2013. The results reveal that the stock market response to oil price shocks is different over time. They finally comment that the US stock market is more responsive to oil price shocks compared to the Chinese stock market, as it exhibits a higher level of correlation with oil price shocks throughout the studied period.

#### **4.5 Studies Related to Bangladesh**

Hassan, Islam and Basher (2002) empirically examine the issue of market efficiency and time-varying volatility and equity returns for the equity market of Bangladesh using GARCH-M model over the 1990-1999 period. They conclude that DSE departs from the efficient market hypothesis as DSE returns display significant serial correlation. The results also show a significant relationship between conditional volatility and the DSE stock returns.

Ahmed and Imam (2007) explore long-term equilibrium relationships as well as short-run dynamic adjustment between a group of macroeconomic variables (industrial production index, broad money supply, interest rate, treasury bill rate and GDP) and the stock price index of Bangladesh by employing cointegration test, vector error correction model and Granger causality test for monthly data series of July 1997 to June 2005. Considering industrial production index, money supply, and GDP growth in the first model, they have found no cointegration among them. When interest rate is added to the previous model, the existence of significant long run relationship observes with money supply, GDP growth, and interest rate change. They also comment that changes of interest rate Granger cause stock market returns unidirectionally which implies that the stock market of Bangladesh is informationally inefficient.

Mohiuddin, Alam and Shahid (2008) investigate the explanatory power of various macro-factors such as inflation rate, exchange rate, interest rate, money supply and production index on the variability of the stock price in Bangladesh. Multiple regression analysis using quarterly data between January, 1987 and December, 2005 has been

conducted to assess the relationship between the stated macroeconomic factors with all share stock prices of DSE. No significant relationship has been found between the stock price and any of the macroeconomic factors.

Afzal and Hossain (2011) examine the relationship between stock prices and four macroeconomic variables (i.e., M1, M2, ER, IFR) for the period July 2003 to October 2011 using cointegration and Granger causality test. The study recommends that the DSE is not informationally efficient with respect to M1, M2 and inflation rate as the long-run equilibrium relation exists between these variables and stock prices. Moreover, there seems to be a dynamic causal link from the stock price to exchange rate changes.

Ali (2011a) investigates the long-run equilibrium relationship as well as causal relationships between the DSE all share price index and four microeconomic variables (i.e., market dividend yield, market price-earnings multiples, monthly average market capitalization and monthly average trading volume) using monthly data from January 2000 to December 2010. By employing Granger causality test, he shows that there is a long-run equilibrium relationship among the variables.

Ali (2011b) examines the explanatory power of three macroeconomic variables (IPI, CPI and FR) and two microeconomic variables (Market P/E and average growth in market capitalization) to explain DSE all share price index for July 2002 to December 2009. By employing multivariate regression model based on standard OLS formula, he finds that inflation and foreign remittance have negative influence, and industrial production index, market P/Es and monthly percent average growth in market capitalization have positive influence on stock returns. Granger causality test exposes no significant causal relation between stock price and selected micro and macroeconomic variables which eventually indicates the evidence of informationally inefficient market.

Ali (2011c) studies the causal relationships between the DSE Stock Index and the thirteen macroeconomic variables such as consumer price index, deposit interest rate (DIR), foreign exchange rate, export payment (X), import payment (M), GDP,



investment, industrial production index, lending interest rate, broad money supply, national income deflator, foreign remittances and total domestic credit (DC) using monthly data for the period 1987 to 2010. By applying the techniques of unit-root tests, cointegration and the long-run Granger causality test proposed by Toda and Yamamoto (1995), he shows that DSI in any way do not Granger cause CPI, DIR, X, GDP, Investment, IPI, LIR and NI deflator. But unidirectional causality is found from DSI to M2, and DC. In addition bi-directional causality is also identified from DSI to ER, M, and FR.

Hossain and Uddin (2011) empirically examine the efficiency and volatility effect of Dhaka Stock Exchange using three different daily price indices DGEN, DSI and DSE20 employing autocorrelation function, ADF and PP tests, ARIMA and GARCH (p, q)-M models. The results do not hold the weak-form of EMH of DSE. The results of GARCH (p, q)-M models indicate that DSE returns tend to display volatility clustering and investors are rewarded for taking increased risk for the securities of DSE-20 and DSI, but not for DGEN. The study also reveals that a massive amount of capital inflow significantly influences the DSE volatility during the periods of caretaker government from 12 January 2007 to 6 January 2009.

Nguyen and Ali (2011) investigate whether the Dhaka Stock Exchange market in Bangladesh is weakly efficient using a set of panel data for the months of March, April and December 2006, and January 2007. 2,250 panel data points (30 stocks x 75 days) are pooled by modifying and estimating Dockery and Kavussanos' multivariate model and the findings recommend that the Dhaka Stock Market is not informationally efficient. They suggest that Bangladesh authority should give attention to build up its market infrastructure to construct an efficient stock market.

Khandoker, Siddik and Azam (2011) investigate the random walk hypothesis to test market efficiency in the Dhaka Stock Exchange, employing runs test, DF unit root test using 2403 daily observations of DGEN from 27 November 2001 to 19 May 2011, 2614 observations of DSI from 01 January 2000 to 19 May 2011 and 2649 daily observations of DSE-20 from 01 January 2001 to 19 May 2011. As a proxy of movement of individual stock prices, daily closing prices of 30 companies operating in the Bank

sector are also considered. The results reveal that DSE does not follow the random walk model and hence the Dhaka stock exchange is not efficient in weak form.

Rayhan, Sarkar and Sayem (2012) examine the volatility of DSE returns using unit root tests and GARCH model for the period of January 1987 to March 2010. They comment that DSE price index follows random walk of EMH, but monthly DSE returns do not follow it. They also reveal that the stock market volatility changes significantly over time and monthly DSE returns follow GARCH properties. At the aggregate level, stock return volatility follows leverage effect or asymmetric volatility as the study uncovers that volatility rises more sharply during stock price declines following bad news than that in periods of stock price increase following good news.

Chaity and Sharmin (2012) test the weak form of efficiency focusing on the random walk model for Dhaka Stock Exchange using DSI and DGEN Indices for the period of January 1, 1994 to June 30, 2011 and January 2002 to June 30, 2011 respectively. The results of serial correlation, auto correlation test, and ARIMA indicate that both indices of Dhaka stock exchange do not follow random walk model. The study concludes that the DSE is not weak form of efficient.

Parvez and Basak (2012) observe the volatility switching of Dhaka stock exchange by transition probability and limiting probability using DSE 20 index data for January 2001 to October 2010. The Limiting Probability is used as an expectation of future manner of the stock market, i.e., how to move or fluctuate in future. From the long run probability, they conclude that Dhaka stock exchange retain 54% of time in low volatility, 35% of time in medium volatility and 11% of time in high volatility.

Quadir (2012) investigates the effects of macroeconomic variables of treasury bill interest rate and industrial production on stock returns on Dhaka Stock Exchange for the period between January 2000 and February 2007 on the basis of monthly time series data using ARIMA model. Though, the ARIMA model reveals that both

treasury bill interest rate and industrial production have positive effect on stock returns, but these effects are statistically insignificant at 5% level of significance. Khan and Yousuf (2013) have a look at the influence of a selective set of macroeconomic forces, such as, deposit interest rate, exchange rate, CPI, crude oil prices and M2 on DSI of DSE using monthly data from 1992:1-2011:6. Long run analysis methods (cointegration and VECM) imply that interest rates, crude oil prices and broad money supply are positively associated with stock prices, whereas exchange rate is negatively associated with stock prices, and CPI is insignificant in influencing the stock prices. Both IRF and VDC mention that shocks to macroeconomic variables justify a little low proportion of the forecast variance error of the DSI, though these effects transmit on for long periods.

Muktadir-al-mukit (2013) investigates the effect of monetary policy variables (money supply, repo rate, inflation rate, and three-month treasury bill rate) on the performance of the stock market of Bangladesh (DGEN Index) using monthly data over the period of January, 2006 to July, 2012. Employing Cointegration technique, he reveals that a one percent increase in inflation, money supply, treasury bill rate and repo rate contributes 1.69 %, 0.38 %, 1.09 % increase and 2.37% decrease in market index respectively in the long run. The ECM model indicates that 26 % of the deviations of stock returns are corrected in the short run. Finally, Granger causality analysis suggests the existence of unidirectional causality from inflation, money supply and treasury bill rate to market index. Therefore, it is suggested that investors should consider the impact of monetary policy during constructing their portfolios and making investment decisions.

Bose, Uddin and Islam (2014) conduct to measure the efficiency level of Dhaka Stock Exchange and Chittagong Stock Exchange, employing ARIMA test. The result of the study shows that Dhaka Stock Exchange and Chittagong Stock Exchanges are not in the form of 'weak efficiency' and 'strong efficiency'. They conclude that both stock markets belong to the 'semi strong' form of efficiency and Chittagong Stock Exchange is more efficient than Dhaka Stock Exchange.

## 4.6 Conclusion

We can draw the following conclusions from the comprehensive literature review. First, most of the researchers suggest that the developed markets are informationally efficient in terms of weak and semi-strong form of EMH, while the emerging stock markets are inefficient in most cases. A number of statistical and econometric tools (both parametric and non-parametric tests) are used to test the weak form efficiency of EMH. The techniques include runs test, Unit Root test, autocorrelation coefficient test, variance ratio test, ARIMA model, and GARCH model. Second, the semi strong form of EMH and the link between stock prices and economic variables (both micro and macro) are examined commonly using a VAR framework, cointegration and Granger causality tests, impulse response functions (IRFs) and variance decompositions. Third, most of the volatility tests are examined with univariate ARCH and GARCH models. The results reveal that stock returns show evidence of the three common characteristics, i.e., leptokurtosis, volatility clustering, and leverage effect. Fourth, the existing empirical studies do not specify the number of variables that should be included in the multivariate efficiency and volatility models, and they are also disappointed to identify a definite guideline for choosing an appropriate set of macroeconomic variables.

Top down analysis of joint testing of EMH and APT for Bangladesh stock market for developed market has scarcely done so far. There is not a sufficient amount of empirical study worldwide based on macroeconomic approach to test semi-strong form efficiency and volatility of stock markets (Khan, 2013). Erdugan (2012) makes an unusual, but strong contribution to Australian stock market in this regard. Erdugan (2012) examines the effect of economic factors on the performance of the Australian stock market. By using the EMH and macroeconomic version of APT model, he employs autocorrelation function and VAR methods, and shows that the Australian stock market is weak form efficient and semi-strong form inefficient. He also reveals that real GDP, labor cost index, and the US S&P 500 index are the three significant macroeconomic variables that can explain the stock market return in Australia.

Few studies around the world have been conducted to test both the efficiency and volatility of the stock market. Most of scholars have used only historical data of stock

index to test efficiency and volatility. The efficiency and volatility test using a top down approach has basically been overlooked. This study tries to fill the gap in the literature as it attempts to explore the efficiency and volatility of DSE by using both univariate and multivariate time series models. Actually, daily stock index data are used for univariate models to test the weak form efficiency and volatility features in DSE, while monthly stock index and macroeconomic variables data are used to test the semi-strong efficiency and impact of macroeconomic variables volatility on volatility of stock returns in DSE. In the next Chapter we specify the number and type of variables that should be included in this study based on the above discussions in Chapter 3 and 4.

## Chapter 5

### Variable Selection and Justification

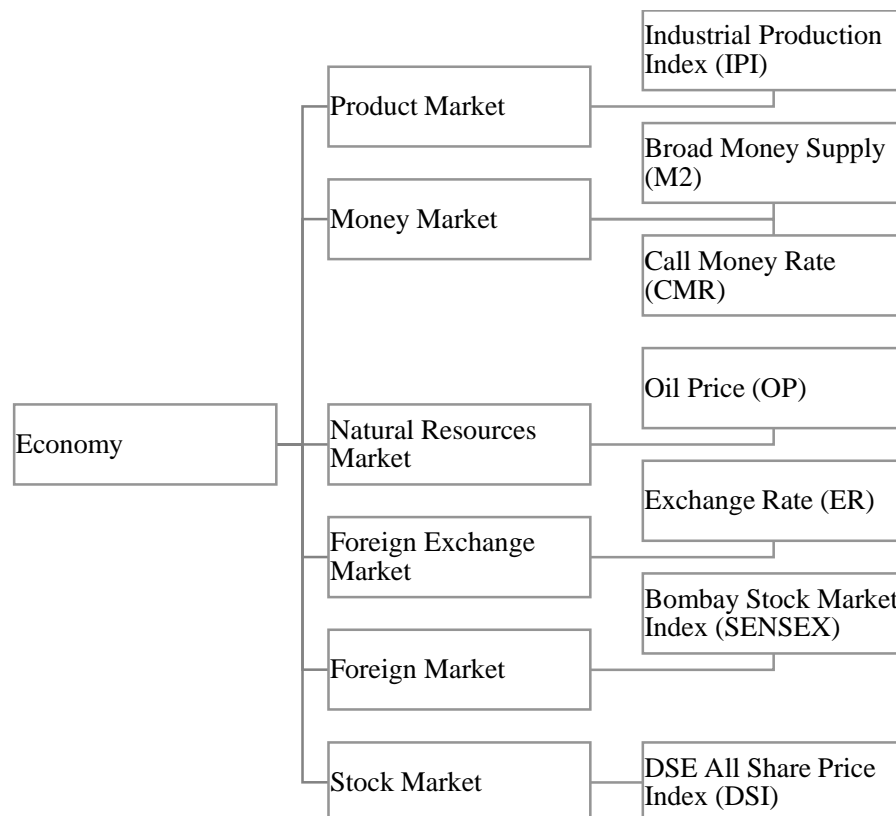
#### 5.1 Introduction

In order to apprehend the efficiency and volatility of the stock market, it is essential to first familiarize economic factors that may have an approximate impact on the stock prices. Anxious investors excitedly look forward to the release of key economic indicators in every month, since these indicators put in the picture of the domestic economy. But do these indicators really have any influence on the movement of stock prices in the short and long-run? In order to find the result of the question, we have already analyzed and realized the major constituent items that drive the economy and stock market using the asset pricing models and empirical literatures reviewed in Chapter 3 and 4. In this Chapter, a univariate model is specified in order to test the weak form of EMH and volatility characteristics of stock returns in Bangladesh stock market. Moreover, a multifactor model is also formulated with the help of macroeconomic version of the APT and the semi-strong form of the EMH. A set of variables is identified after appropriate scrutiny. Upon appropriate validation process, the variables are hypothesized and also discussed the measurement procedure before considering them in the model for empirical analysis.

Macroeconomics is a branch of economics that deals with the performance, structure, behavior, and decision making of the entire economy. The key macroeconomic variables can describe the health of an economy and can summarize the most important characteristics of the economy. This study adopts the core fundamental of macroeconomics as variables are selected from the major economic markets considering that markets coordinate the macroeconomic activities through the well-known price mechanism. These markets are product market, stock market, money market, natural resource market, foreign exchange market, and foreign market. Dhaka Stock Exchange is considered as the representative of the stock market of Bangladesh, since it is oldest and largest stock market in Bangladesh. This study selects DSE all-share price index (DSI) for the univariate models as it covers most of the stocks in the

country. Based on the theoretical and empirical literature reviewed in chapter 3 and 4, this study investigates six macroeconomic variables for the multivariate models that might have a significant impact on the most important stock market variable of Bangladesh, named all share price index (DSI). For the multivariate models, DSE all-share price index (DSI) from the stock market is considered as the dependent variable. In contrast, six macroeconomic variables are considered as the explanatory variables from the major markets that coordinate the macroeconomic activities. Industrial production index (IPI) as a proxy of GDP from the product market, broad money supply (M2) from the money market and call money rate (CM) as a proxy of interest rate from the money market, crude oil price (OP) from the natural resources market, exchange rate (ER) from the foreign exchange market and one of the Indian (Bombay) stock market index (SENSEX) from the foreign market are used as independent variables.

**Figure 5.1: Selected Variables from Major Economic Markets**



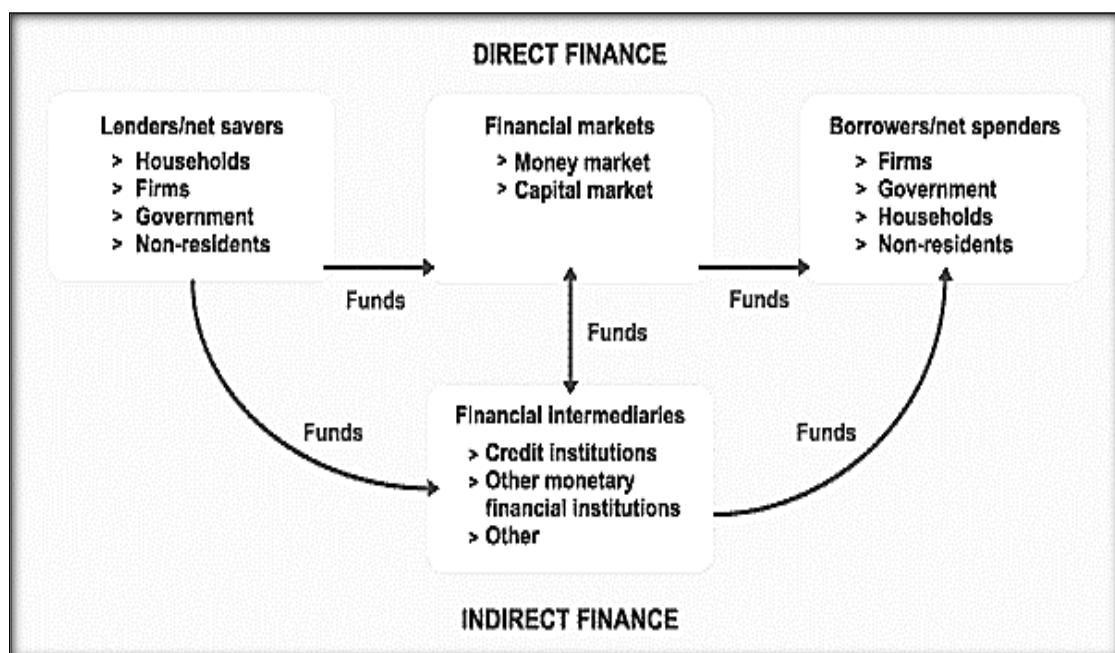
The variables that are picked from major economic markets are depicted in Figure 5.1. In the following sections, we briefly validate the inclusion of each macroeconomic

variable. After validation procedure, we give an idea about the hypothesized relationships and measurement procedure of the variables.

## 5.2 Stock Market and The Economy

The stock market is a sophisticated market, where government and industries can raise long-term capital by issuing securities, and investors can purchase and sell these securities. The stock market can be considered as the creator of a strong and modern economy as it is more flexible and dynamic financial system than a traditional, rigid and insecure bank based financial systems. Stock market contributes to economic growth through direct and indirect finance between lender-savers and borrower-spenders. The economic system comprises of millions of economics units that are usually come together in four groups: households, businesses, government and foreigners.

**Figure 5.2: Flow of Funds through the Financial System**



Source: Mishkin and Eakins (2003)

In order to make possible business decisions, the economic units have to move funds from lenders to borrowers through direct finance of financial markets (e.g., capital and money market) and indirect finance of financial intermediaries (e.g., banks, financial



organizations etc.). Figure 5.2 shows that borrower-spenders must borrow funds from lenders-savers to finance their spending in two ways. The first is an indirect transfer by financial intermediaries that play a role of mediator, using debt instruments and invest it in shares or bonds etc., and the second is a direct transfer by financial markets using financial instruments like securities and debt instruments.

Economic theory recommends that there ought to be a solid connection between economic activity and security prices, given that the stock price is dependent on the company's profits and interest rates. The standard Present Value Model (PVM) or discounted cash flow model suggests that stock prices follow real economic activity. The price of the stock, according to the Discounted Cash Formula is:

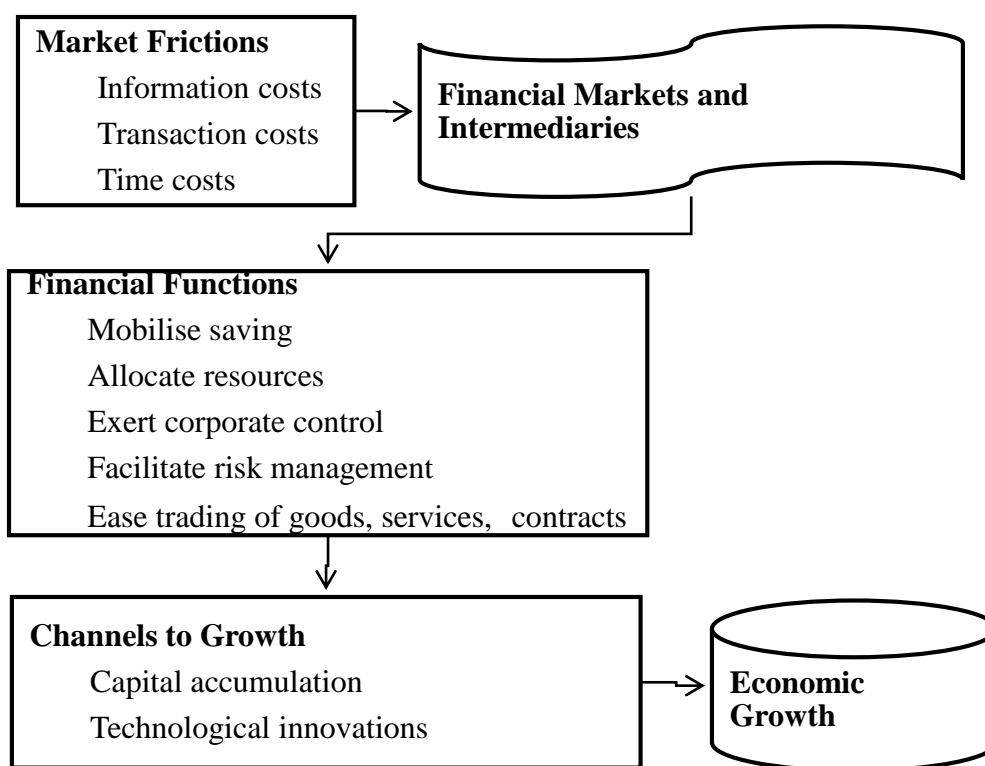
$$P_t = \frac{Div_1}{(1+r_1)^1} + \frac{Div_2}{(1+r_2)^2} + \dots + \frac{Div_t}{(1+r_t)^t} \quad (5.1)$$

So, macroeconomic factors that refer to the future brighter times and more profits for the companies that increasing industrial production does have a positive effect on the stock prices and vice versa. This is the decent theoretical argument in the matter of how stocks and real economic activity may be connected.

Although, the initiatives of relating economic growth to the financial development were performed long ago, that mainly emphasize the role of the banking sector to the economic growth. Ahmed and Mmolainyane (2014) claim that the causal relationship between financial development and economic growth are outlined along three connections: (i) financial deepening stimulates economic growth; (ii) economic growth motivates financial development; and (iii) financial development and economic growth influence each other. McKinnon (1973) and Shaw (1973) insist the link from financial deepening to growth, while Goldsmith (1969) proves the opposite direction. More interestingly, Luintel and Khan (1999) find the bi-directional causality between financial development and economic growth in all 10 sample countries. The emerging vitality of stock markets around the world during the last few decades has shifted the center of experts to explore the relationship between stock market development and economic growth. The empirical literatures provide the contrasting results on the impact of stock market development on economic growth. Levine (1991), Atje and Jovanovic (1993), Levine and Zervos (1996), Olweny and Kimani (2011), Deb and Mukherjee

(2008), *among others*, argue that stock market development significantly promotes economic growth of a country both directly and indirectly. Hossain and Kamal (2010) explore that stock market of Bangladesh does have an effect on the real economic activity. Whatever the findings explore, it goes without saying that there are two most important channels through which stock market may influence economic growth. First, a developing stock market makes room for increasing saving rates. Second, the financial institutions endeavor the effectual economic function of increasing the channel of funds from lenders to borrowers by reducing information and transactions costs, and therefore improves the allocation of resources. For example, Levine (1997) argues that five financial functions affect saving and allocation decisions and influence economic growth rates, as Figure 5.3 exhibits.

**Figure 5.3: Theoretical Approaches to Finance and Growth**

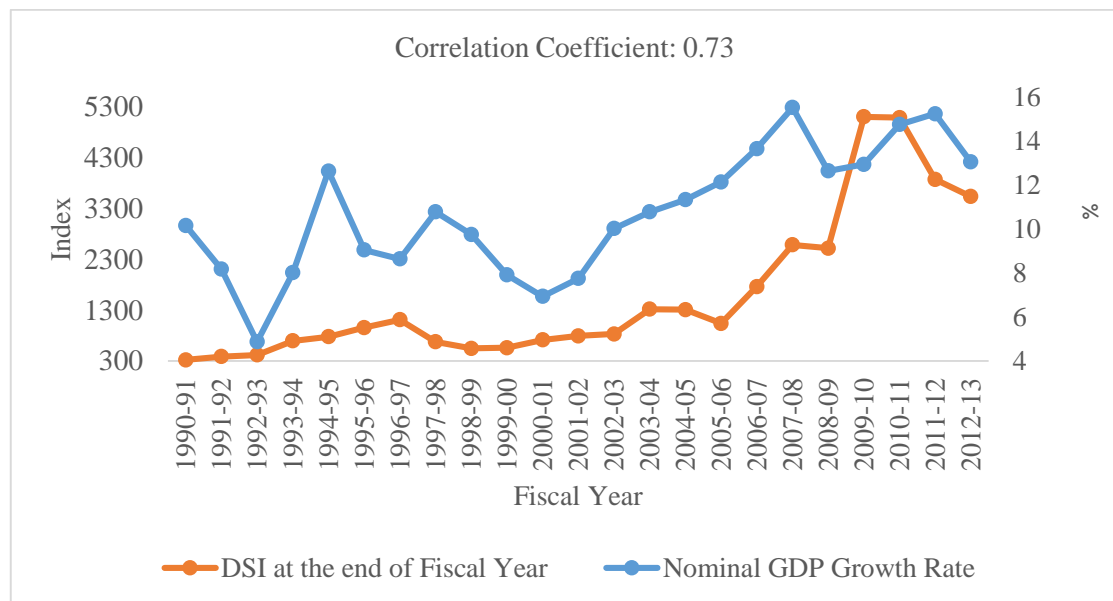


Source: Adapted from Levine (1997)

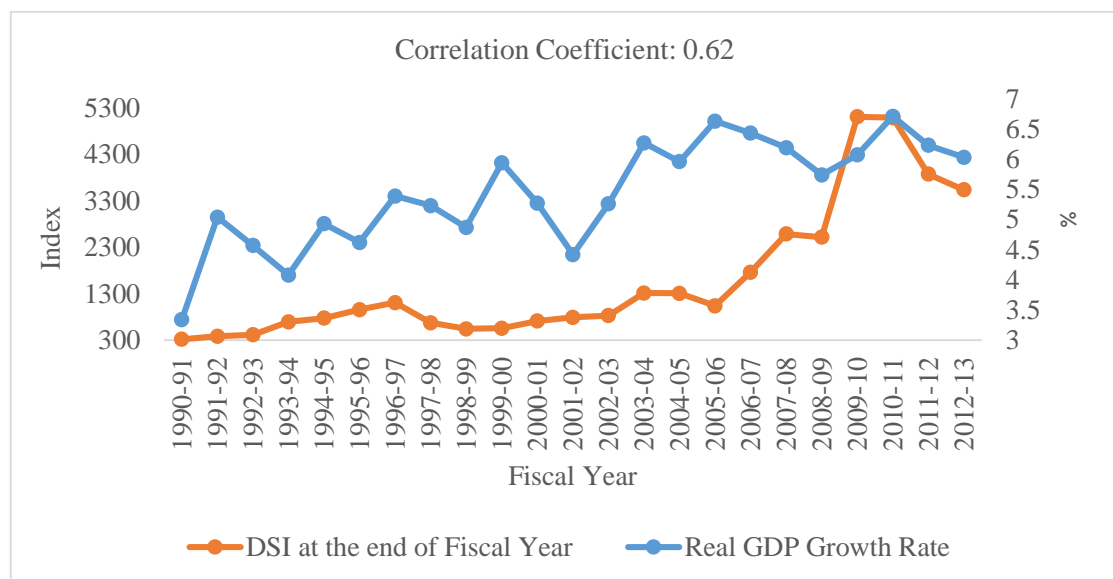
Figure 5.4 reveals the relationship between stock market index and annual nominal growth rate of GDP between fiscal year 1990-91 and 2012-13. The correlation coefficient between stock market index and annual nominal GDP growth rate is 0.73.

Figure 5.5 illustrates the relationship between stock market index and annual real growth rate of GDP between fiscal year 1990-91 and 2012-13. The correlation coefficient between stock market index and annual real GDP growth rate is 0.62. Both Figures show that the variables move almost in the same direction and there is a close and meaningful relationship exists between the economy and stock market in Bangladesh.

**Figure 5.4: DSI and Annual Growth of GDP at Current Market Price from FY 1990-91 to 2012-13**



**Figure 5.5: DSI and Annual Growth of GDP at Constant Market Price from FY 1990-91 to 2012-13**



### 5.3 Stock Market Variables and DSI

There are ample of variables of the stock market that can predict the behavior of the market. The main stock market variables are as follows:

- Stock Prices / Stock Index
- Stock Market Size
- Stock Market Liquidity
- Initial Public Offerings
- Price/Earning (P/E) Ratio
- Earning Per Share (EPS)
- Amount of Dividend/ Dividend Announcement/ Dividend Yield
- Market Capitalization
- Trading Volume
- Rating Announcement etc.

The core stock market variable is stock index as it allows us a thought about the market as a whole. Conventionally, stock indices are treated as leading powerful information sources of a stock exchange. Every stock price reacts for two probable reasons -news about the company and news about the economy. Moreover, an index is accumulated an average of returns on many stocks in which each stock acquires in two news- stock's company news and index news. So, a stock index figure is the current relative value of a weighted average of the prices of a pre-defined group of equities.

Dhaka Stock Exchange is the country's leading stock exchange, and all share price index (DSI) of DSE covers majority of the stocks in the country. DSI is used as a proxy for stock prices as it allows a more comprehensive analysis. DSI perfectly reflects the behavior of the overall stock market of Bangladesh as well as of different portfolios. DSE uses three share price indices-DSE All Share Price Index (DSI), DSE General Price Index (DGEN) and DSE-20 before starting Standards & Poor's supported DSE Broad Index (DSEX) and DSE 30 Index (DS30) in 28 January 2013. None of the DSE indices included mutual funds, bonds, and debentures. DSI index forms with all shares price of all categories, while DGEN includes all share price except 'Z' categories and DSE-20 structures with the 20 best enlisted companies depending on performance and

specific criteria. DSE calculates DSI index according to International Organization of Securities Exchange Commissions (IOSCO) Index Methodology using the base index 350 as on 01 November 1993 as:

$$\text{Closing Index} = \frac{\text{Yesterday's Closing Index} \times \text{Closing Market Capitalization}}{\text{Opening Market Capitalization}}$$

where Closing Market Capitalization =  $\sum$  (Closing Price X Total number of indexed shares).

DSI is a good index as it gives each stock a weight proportional to its market capitalization. Thus, the overall performance of all listed companies in DSE have reflected on DSI and therefore, it is expected that DSI provides better insight into the overall performance of the Bangladesh stock market.

## **5.4 Product Market Variables (IPI as a proxy of GDP) and Stock Market**

Economic theories and empirical studies anticipate that there is a positive relationship between the product market and the stock market. Erdugan (2012) argues that the positive relationship is ascribed to changes in the nominator and denominator impact in a valuation model. Product markets take account of the goods and services that households buy and make payments to the firms who sell goods and services in exchange of money, for example, food from supermarkets, cloth from readymade garments etc. Well-functioning product markets perform a vital role in providing the higher economic growth and improve standard of living for the citizens. There are a lot of variables of the product market that might have a satisfactory relationship with the stock market. The main product market variables are:

- GDP and its components
- Inflation
- Consumer Price Index
- Industrial Production Index.

These variables and indicators are intently kept under observation in financial markets because of the effects on stock market return. Among these, GDP is the most commonly and comprehensively used measure of the performance of an economy's overall economic activity. The higher the growth rate of GDP, others things being equal, the more favorable it is for the stock market (Chandra 2004). So, a positive relationship between GDP and DSI is hypothesized. The GDP is not calculated every month and not even every quarter in Bangladesh. Thus, industrial production index (IPI) is used as a proxy of GDP for this study as monthly data of IPI are available in Bangladesh. Moreover, IPI becomes more vital component of the economy of Bangladesh as the contributions of the industrial sector in GDP are increasing with a decent pace over the last twenty years.

Index of industrial production is one of the best statistical data which denote the status of production in the industrial sector for a given period of time compared to a reference period of time. IPI is a short term indicator which helps us to measure the level of industrial activity in Bangladesh economy. The Bangladesh Bureau of Statistics (BBS) compiles and disseminates a range of indices for industrial production. To assess movement of industrial production in Bangladesh, BBS collects data from state owned manufacturing enterprises and major manufacturing enterprises in the private sector on a monthly basis. IPI data are broadly divided into three segments – General (manufacturing), Jute and Textiles, and others. This study uses data of general (manufacturing) index. The weights in the index are based on the 1988-89 Census of Manufacturing Industries (CMI). The base year is 1988-89, and a Laspeyres weighted formula is used to calculate the index.

Data unavailability on a monthly basis of GDP restricts us to use IPI as an alternative to measure the growth rate in real sector. Generally, a rise in industrial production signals the economic growth and industrial production affects stock prices through its influence on expected future cash flows. The increased consumer spending leads to higher demand situation and thus producers respond by increasing the production. High industrial production results in higher corporate sales and profits, which directly affect stock prices through dividends. As dividend increases, it results in increase of share prices. Thus, it is expected that an increase in industrial production index is positively related to stock price according to economic theory. The opposite causes a fall in the

stock prices. Studies such as, Chen et al. (1986), Naka et al. (1988), Naik and Padhi (2012), Quadir (2012), Hsing (2013) find a positive relationship between IPI and stock prices.

### **Some of the Previous Studies which Apply IPI as an Independent Variable**

Chen et al. (1986), Malliaris and Urrutia (1991), Najand and Noronha (1998), Kwon and Shin (1999), Naka et al. (1988), Ahmed and Imam (2007), Mehrara (2006), Kazi (2008), Mohiuddin et al. (2008), Ali et al. (2010), Srivastava (2010), Ali (2011b), Ali (2011 c), Herve et al. (2011), Laopodis (2011), Naik and Padhi (2012), Quadir (2012), Ray (2012), Masduzzaman (2012), Sabunwala (2012), Zakaria and Shamsuddin (2012), Naik (2013) and Hsing (2013).

## **5.5 Money Market Variables (M2 and CMR) and Stock Market**

The empirical studies of financial economics frequently make use of the money market variables to figure out the stock market behavior as the economic theories contend that the two markets are closely related. In the analysis of the stock market behavior, major money market variables that are thoroughly examined include:

- Money Supply (M1, M2, M3)
- Deposit Interest Rate
- Lending Interest Rate
- Call Money Rate
- Total Domestic Credit.

The achievement of macroeconomic goals is a policy precedence of each and every economy. Fiscal and monetary policies are the main instruments of achieving the macroeconomic goals, while the Monetarists believe that monetary policy exert a greater effect on economic activity. Monetary policy is concerned with a program of action undertaken generally by the central bank to control and regulate the supply of money and credits to adjust interest rate with a view to achieving predetermined macroeconomic goals. This study uses two widely used money market variables, namely, broad money supply (M2) as a proxy of money supply, and call money rate

(CMR) as a proxy of interest rate. The money supply and its prudent management and control through the monetary policy pursued by the central bank of Bangladesh named Bangladesh Bank. In economics, several alternative indicators such as, M1, M2, M3 money are used as measures money supply in a country.

The statistics department of Bangladesh Bank compiles and disseminates M2 data which consist of

$M2 \text{ (Broad Money)} = M1 \text{ (Narrow Money)} + \text{Time Deposits};$

where M1, Narrow Money consists of

- Currency in circulation (C) which includes the notes and coins that we use,
- Demand Deposits (DD) in the banking system.

So, M2 includes currency outside banks plus demand deposits plus deposits with Bangladesh Bank other than Deposit Money Banks (DMBs) plus time deposits.

Although, money supply is widely used in the literature to determine the stock prices, the relationship between money supply and stock price is still ambiguous. According to the portfolio theory, stock prices tend to move higher when the money supply in an economy is high as plenty of money circulating in the economy makes more money available to invest in stocks. Moreover, investors rationally switch from a noninterest bearing money assets to financial assets like stock, and also bonds become less attractive. Mukherjee and Naka (1995) argue another point that if money supply brings the economic stimulus, then the resulting corporate earnings in turn increase the stock prices. For Example, Mukherjee and Naka (1995), Pilinkus and Boguslauskas (2009), Eita (2012), Naik and Padhi (2012), Ray (2012), Hsing et al. (2012), Vejzagic and Zarafat (2013), Muktadir-al-mukit (2013) and Naik (2013) find positive relationship between money supply and stock prices. On the other hand, an increase in money supply causes the inflation to be increased, which one at a time may raise the discount rate and therefore reduce the stock prices. Few studies, such as, Isenmila and Erah (2012), Rahman et al. (2009) find that there is a negative relationship between money supply and stock prices. Therefore, a positive relationship is expected between money supply and stock prices as most of the previous studies support this statement, although money supply has a dual effect on stock prices.



### **Some of Previous Studies which Apply Money Supply as an Independent Variable**

Malliaris and Urrutia (1991), Kwon and Shin (1999), Naka et al. (1988), Gunasekarage, Pisedtasalasai and Power (2004), Mehrara (2006), Ahmed and Imam (2007), Mohiuddin et al. (2008), Pilinkus and Boguslauskas (2009), Ali (2011c), Adaramola (2011), Afzal and Hossain (2011), Apergis, Artikis and Eleftheriou (2011), Herve et al. (2011), Barbic and Condic-Jurkic (2011), Naik and Padhi (2012), Eita (2012), Ray (2012), Hsing et al. (2012), Masuduzzaman (2012), Isenmila and Erah (2012), Zakaria and Shamsuddin (2012), Osamwonyi and Evbayiro-Osagi (2012), Adu et al. (2013), Vejzagic and Zarafat (2013), Naik (2013), Hsing (2013), Khan and Yousuf (2013) and Muktadir-al-mukit (2013).

Other than money supply, interest rate is the most used macroeconomic factors to determine the stock returns. Like Ray (2012) and Patel (2012), this study uses call or notice money rate as a proxy of interest rate. Weighted average call money borrowing market rates published by debt management department of BB are used as a proxy of interest rate. It is expected that there is a negative relationship between CMR and DSI. The logics behind the negative relationship between interest rate and stock prices are elegantly explain by Alam and Uddin as:

‘Generally, interest rate is considered as the cost of capital, means the price paid for the use of money for a period of time. From the point of view of a borrower, interest rate is the cost of borrowing money (borrowing rate). From a lender’s point of view, interest rate is the fee charged for lending money (lending rate). ... if the rate of interest paid by banks to depositors increases, people switch their capital from share market to bank. This will lead to decrease the demand of share and to decrease the price of share and vice versa. On the other way, when rate of interest paid by banks to depositors increases, the lending interest rate also increases leads to decrease the investments in the economy which is also another reason of decreasing share price and vice versa.’ (2009, p. 53)

So, the economic theories assert that there is an inverse relationship between share price and interest rate. Studies, such as, Pilinkus and Boguslauskas (2009), Aurangzeb

(2012), Hsing et al. (2012), Eita (2012), Vejzagic and Zarafat (2013) find negative relationship between interest rate and stock prices.

### **Some of the Previous Studies which Apply Interest Rate or CMR as an Independent Variable**

Naka et al. (1988), Ahmed and Imam (2007), Mohiuddin et al. (2008), Pilinkus and Boguslauskas (2009), Srivastava (2010), Ali (2011c), Adaramola (2011), Herve et al. (2011), Barbic and Condic-Jurkic (2011), Aurangzeb (2012), Eita (2012), Hsing et al. (2012), Kenani et al. (2012), Ray (2012), Patel (2012), Sabunwala (2012), Isenmila and Erah (2012), Zakaria and Shamsuddin (2012), Masuduzzaman (2012), Adu et al. (2013), Khan and Yousuf (2013) and Vejzagic and Zarafat (2013).

## **5.6 Natural Resources Market Variables (OP) and Stock Market**

Natural resources market deals with the supply, demand, and allocation of the natural resources. In the analysis of the stock market behavior, major natural resources market variables that are thoroughly examined include:

- Crude Oil Price
- Gold Price

Crude oil is the lifeblood of modern economies since it is a very important input for production and so, the price of oil is widely incorporated as an explanatory variable in order to analysis the stock market behavior. The demand for oil of Bangladesh increases significantly with an effective economic growth, rapid urbanization and increased industrialization and development. Future oil demand is not easy to predict but is largely associated with the growth in industrial production. Bangladesh is largely a net importer of crude oil. In 2013, the country produced 4,500 barrels per day of total oil and consumed nearly 119,000 barrels per day, while oil consumption was only 30,000 barrels per day in 1983. (U.S. Energy Information Administration 2015). So, Bangladesh continues to increase its crude oil imports to satisfy her domestic demand and thus oil price takes part a crucial role in Bangladesh economy. This study uses the widely employed resources market variable, namely, crude oil price (OP) and data of

OP (\$/Barrel, Dubai Medium) are collected from the several issues of monthly Economic Trends of Bangladesh Bank.

Energy, financial markets and the economy are all explicitly linked together on a country's path of economic growth. It is often argued that the price of oil must be incorporated in any list of systematic factors that influence stock market prices (Chen, Roll and Ross 1986). Oil price volatility increases risk and uncertainty which negatively impacts stock prices and reduces wealth and investment (Basher and Sadorsky 2006). By using recently developed frequency domain methods, Ciner (2013) shows that there is significant time variation in the linkage between oil and equities. Oil price shocks with less than 12-month persistency have a negative impact on stock returns, while shocks with persistency between 12 and 36 months are associated with positive stock returns.

It goes without saying that any significant increase in oil prices guides to worries in the stock market, which may perhaps motivate investors to postpone their investments. In addition, the increase in oil prices leads to higher transportation and production costs which have a negative effect on corporate earnings and consequently a negative impact on stock returns. Increased oil prices also lead to inflation and diminish consumer spending results lower demand situation. Thus rising oil prices results in lower corporate sales and profits, which directly dampens stock prices through dividends. Therefore, an increase in the price of oil in Bangladesh means lower real economic activity in all sectors which cause stock price to fall. However, Khan and Yousuf (2013) find a positive relationship between share prices and oil prices in the context of Bangladesh; most of the studies, such as, Isenmila and Erah (2012) and Ray (2012) argue that there is an inverse relationship between share prices and oil price.

### **Some of Previous Studies Applying Crude Oil Price as an Independent Variable**

Basher and Sadorsky (2006), Adaramola (2011), Laopodis (2011), Kuwornu and Owusu-Nantwi (2011), Ray (2012), Isenmila and Erah (2012), Khan and Yousuf (2013) and Broadstock and Filis (2014).

## **5.7 Foreign Exchange Market Variables (ER) and Stock Market**

Foreign exchange market or forex market is considered to be the largest financial market in the world in which participants are able to buy, sell, exchange and speculate on currencies. Foreign exchange markets are made up of banks, commercial companies, central banks, investment management firms, hedge funds and retail forex brokers and investors. Foreign exchange rate (ER) is the dominant macroeconomic variable that is extensively used to find impacts on a domestic stock market. The foreign exchange rate is a price of a nation's currency in terms of another currency. This study uses monthly average Taka (Bangladesh currency) per U.S dollar exchange rate as foreign exchange rate.

Katechos (2011) investigates the relationship between stock markets and exchange rates, and reveals that exchange rates and global stock market returns are strongly linked. Directly or indirectly, exchange rates affect a number of key economic variables of a country. The foreign exchange rate has a direct impact on the following aspects of the economy:

- Balance of Trade (Exports and Imports)
- Economic Growth
- Foreign Direct Investment and Foreign Portfolio Investment
- Inflation
- Interest Rates
- Stock Prices.

Andreou, Matsia and Savvides (2013) argue that flow or traditional approach and portfolio-balance approach are two broad channels that link stock prices and foreign exchange rate. The flow or traditional approach concentrates on the trade balance and asserts that a depreciation improves country's external competitiveness and thus its trade balance and ultimately real output. As a result, the profitability and expected cash flows of firms increase and thus stock returns. Studies, such as, Hsing et al. (2012), Aurangzeb (2012), Sabunwala (2012) and Rizeanu and Zhang (2013) show that there is a positive relationship between exchange rate and stock prices.

The second theoretical basis is the portfolio-balance approach. In this approach, a decline in stock prices triggers a decrease in the wealth of domestic investors, which consecutively guides to a lesser demand for money with following lower interest rates. Lower interest rates may promote capital outflows, which cause local currency depreciation one at a time. In this case, stock price is expected to lead exchange rate with a negative correlation. Studies, such as, Pilinkus and Boguslauskas (2009), Kuwornu and Owusu-Nantwi (2011), Vejzagic and Zarafat (2013), Jain (2013), Isenmila and Erah (2012) and Khan and Yousuf (2013) show that there is a positive relationship between exchange rate and stock prices.

Contrary to the traditional approach, an import dominated country like Bangladesh, exchange rate depreciation may have an adverse impact on stock prices of DSE. Since Bangladesh currency depreciates against the U.S. dollar, products imported become more expensive. Thus, if the demand for imported goods is elastic, the profitability and expected cash flows of firms may decrease and thus stock returns. As a result, a negative relationship is anticipated between foreign exchange rate and stock returns; however, whether the depreciation or appreciation of the Taka would improve or harm stock prices remains to be an empirical query.

### **Some of the Previous Studies which Apply ER as an Independent Variable**

Kwon and Shin (1999), Gunasekarage, Pisedtasalasai and Power (2004), Islam et al. (2005), Mohiuddin et al. (2008), Kazi (2008), Pilinkus and Boguslauskas (2009), Rahman and Uddin (2009), Ali et al. (2010), Sharma and Mahendru (2010), Srivastava (2010), Ali (2011c), Adaramola (2011), Afzal and Hossain (2011), Herve et al. (2011), Kuwornu and Owusu-Nantwi (2011), Naik and Padhi (2012), Kenani et al. (2012), Ray (2012), Masuduzzaman (2012), Zakaria and Shamsuddin (2012), Hsing et al. (2012), Osamwonyi and Evbayiro-Osagi (2012), Kisaka and Mwasaru (2012), Aurangzeb (2012), Isenmila and Erah (2012), Sabunwala (2012), Singh et al. (2012), Tsai (2012), Eita (2012), Adu et al. (2013), Vejzagic and Zarafat (2013), Naik (2013), Jain (2013), Rizeanu and Zhang (2013), Hsing (2013) and Khan and Yousuf (2013).

## **5.8 Foreign Market Variables (Indian Stock Market: SENSEX) and Stock Market of Bangladesh**

A rising volume of empirical evidences detected by numerous researchers, such as, Kazi (2008), Srivastava (2010), Alshogeathri (2011), Erdugan (2012), Kenani et al. (2012), Hsing et al. (2012) and Hsing (2013) show the way that a series of both domestic and international financial and macroeconomic variables have had a role in predicting home country's stock market returns. It is usually expected that domestic economic fundamentals take part in decisive role in the performance of the stock market. However, in the globally integrated economy, domestic economic variables are also subject to change due to the policies adopted and expected to be adopted by other countries or some global events (Singh et al., 2012). Due to globalization, Bangladesh is in a process of interaction and integration among the people, companies, and economies of different nations. The intensity of integration of financial markets all over the world has grown considerably since late 1980s and early 1990s with the beginning of globalization endeavor. Bangladesh has moved into the process in early 1990s, while a series of steps have taken, such as, inflows of capital by easing restrictions on capital and money market, deregulating domestic financial markets, developing her economic environment through the introduction of market-oriented reforms, broadening capital market development. Thus, the global stock market index would have some spillover effect on the Bangladesh stock market.

A considerable quantity of research concentrates on the integration of stock markets across economies. Morelli (2010) and Febrian and Herwany (2007) give attention to the markets with close geographic proximity. Morelli (2010) investigates the integration between the capital markets of 15 European countries, all of which are members of the European Union. Integration is tested under the joint hypothesis of a European multifactor asset pricing model. The results show that a degree of capital market integration is existed across the European capital markets. Febrian and Herwany (2007) examine the long-term equilibrium relationship among three major South-East Asian equity markets (i.e., JKSE, KLSE and STI) from January 1997 to December 2006. By employing cointegration and error-correction method, they find that the price indices of the three markets are cointegrated. The existence of a linear combination of

the three indices that forces these indices to have a long-term equilibrium relationship implies that the indices are perfectly correlated in the long run.

According to Dekker, Sen and Young (2001), markets with strong economic ties and close geographic proximity are more closely linked than the isolated market. In this line of thinking, Pan, Liu and Roth (1999) use Johansen's cointegration test and a modified cointegration test with GARCH effects to examine linkages between the U.S. and five Asian-Pacific stock markets (Australia, Hong Kong, Japan, Malaysia and Singapore) during the period from 1988 to 1994. The results indicate that the six stock markets are highly integrated through the second moments of stock returns but not the first moments. Another interesting research is done by Abbas, Khan and Shah (2013) who investigate the presence of volatility transmission among regional equity markets of Pakistan, China, India and Sri Lanka. Moreover, for developed countries, the stock indices of USA, UK, Singapore and Japan are considered. Results among the developed and Asian countries show that volatility transmission is present between friendly countries of different regions with economic links. They find some evidence of transmission of volatility between countries (Pakistan and India) which are on unfriendly terms. The study importantly reveals that volatility spillover among the four Asian countries is mostly from a larger market to a smaller market.

The most popular thinking is the integration of financial markets of a country with those countries which fall in the same geographical region or with which it maintains a good relationship with commerce and trade. That is why, this study selects the Bombay Stock Exchange (BSE) of Indian stock market as a foreign market variable. The BSE is the oldest stock exchange in Asia and premier stock exchange in India. The market capitalization of the listed companies in the BSE is about USD 1.6 trillion (Aurangzeb, 2012). This study aims to examine whether the international market contributed to movements of the DSE during the sample period, 2001-2012. To accomplish this goal, we include SENSEX (BSE-30) of BSE which is the widely used index by the researchers of financial economics. Prior research suggests an inverse relationship between geographic distance and financial market linkages.

## **Some of Previous Studies applying Foreign Stock Market Index as an Independent Variable**

Kazi (2008), Srivastava (2010), Alshogheathri (2011), Erdugan (2012), Kenani et al. (2012), Hsing et al. (2012) and Hsing (2013).

### **5.9 Measurement of the Variables in the Suggested Models**

Based on financial economics literature, a set of variables is identified from the representation of the stock market, goods market, money market, natural resources market, foreign exchange market and foreign market. We use monthly data of all the variables covering the period from January 2001 to December 2012 (144 monthly observations) to investigate the semi-strong form of EMH, LR-SR relationship and the volatility of the DSE return in response to the volatility of the six macroeconomic variables, while daily data of the DSI covering the period from 02 January 1993 to 27 January 2013 (4824 daily observations) to investigate the weak form of EMH and the nature of volatility characteristics of stock returns that prevails on the Bangladesh stock market.

All data series are transformed to natural logarithms. The rationale for considering log is that taking the natural logarithm of a series effectively linearizes the exponential trend (if any) in the time series data as the log function is the inverse of an exponential function (Asteriou and Price, 2007). The measurement procedures of the selected variables are described in the Table. 5.1, 5.2 and 5.3.

**Table 5.1: Measurement Procedure of the Variable for the Univariate Efficiency and Volatility Models**

<b>Variables Name</b>	<b>Variable Symbol</b>	<b>Daily Returns</b>
All Share Price Index of DSE (Proxied for Share Prices of Bangladesh Stock Market)	DSI	$(LNDSI_t - LNDSI_{t-1}) \times 100$



**Table 5.2: Measurement Procedure of the Variables for the Multivariate Efficiency Models**

Variables Name	Variables Symbol	Monthly Logged Data
All Share Price Index of DSE (Proxied for Share Prices of Bangladesh Stock Market)	DSI	$LNDSI_t$
Industrial Production Index (Proxied for GDP)	IPI	$LNIPi_t$
Broad Money Supply	M2	$LNM2_t$
Call Money Rate (Proxied for Interest Rate)	CMR	$LNCMR_t$
Crude Oil Price	OP	$LNOP_t$
Exchange Rate	ER	$LNER_t$
Bombay Stock Exchange Index (Proxied for Share Prices of Indian Stock Market)	SENSEX	$LNSENSEX_t$

**Table. 5.3: Measurement Procedure of the Variables for the Multivariate Volatility Models**

Variables Name	Variables Symbol	Monthly Returns/Changes
All Share Price Index of DSE (Proxied for Share Prices of Bangladesh Stock Market)	$\Delta DSI$	$LNDSI_t - LNDSI_{t-1}$
Industrial Production Index (Proxied for GDP)	$\Delta IPI$	$LNIPi_t - LNIPi_{t-1}$
Broad Money Supply	$\Delta M2$	$LNM2_t - LNM2_{t-1}$
Call Money Rate (Proxied for Interest Rate)	$\Delta CMR$	$LNCMR_t - LNCMR_{t-1}$
Crude Oil Price	$\Delta OP$	$LNOP_t - LNOP_{t-1}$
Exchange Rate	$\Delta ER$	$LNER_t - LNER_{t-1}$
Bombay Stock Exchange Index (Proxied for Share Prices of Indian Stock Market)	$\Delta SENSEX$	$LNSENSEX_t - LNSENSEX_{t-1}$

## 5.10 Conclusion

Although the relationship between stock prices and the economic variables could vary from market to market, it may be changed in different sample periods and also in different frequency of the data. This Chapter carefully identifies some economic variables after appropriate scrutiny in order to test the efficiency and volatility of the Dhaka Stock Exchange. The next Chapter presents the econometric methods that we use in this thesis.

## **Chapter 6**

### **Methodology**

#### **6.1 Introduction**

Research methodology is a way of systematically fixing and analysing the research problems. This part of the study covers the research methodology to seek out the results of research questions. The research design is descriptive and analytical with an intention of examination and evaluation of efficiency and volatility of the Dhaka Stock Exchange. The study adopts the deductive manner as research approach. It begins by having a look at theory, produces hypothesis from that theory which relate to the point of interest of study, and then proceeds to check that theory (Greener, 2008). This research takes advantage of quantitative approach with a post-positivist type of paradigm. However, the positivistic paradigm is the most commonly adopted philosophy in business research, as noted by Hussey and Hussey (2003). According to positivism, the world runs in accordance with fixed laws of cause and effect. Scientific thinking is operated to test theories about these laws, and reject or provisionally accept them. Contrary to positivists, post-positivists trust that research can never be certain. Rather than finding the truth, post-positivists make an effort to uncover reality as best they can.

In order to analyze empirical characteristics of the stock market, the application of financial econometric methods is essential. This thesis presents an exposition of how modern econometric techniques can be utilized to understand the behavior of Dhaka Stock Market. A set of financial econometric methods is carefully chosen, ensuring that they are appropriate to the study of various issues of the Bangladesh stock market. Methods and models include the standard descriptive statistical methods and econometric techniques.

The remainder of the current chapter is organized as follows. Section 6.2 organizes the research methods, while subsection 6.2.1 reviews the descriptive statistical methods and subsections 6.2.2 to 6.2.6 present the econometric methods. Descriptive statistics

methods include mean, median, standard deviation, skewness and kurtosis, while econometric techniques include autocorrelation analysis, run test, unit root tests, cointegration, vector error correction, Granger causality, GARCH (p,q), EGARCH and GARCH-S models. Finally, section 6.3 presents a brief conclusion of this Chapter.

## **6.2 Research Methods**

This research makes use of the quantitative methods because it mostly deals with numerical data, which can be analyzed using econometric data analysis procedure. Greener (2008) argues that a quantitative approach to research could be related to a deductive way to checking out theory, regularly the use of quantity or reality and due to this fact an objectivist view of objects studied.

For this study, DSE all-share price index (DSI) is considered as the dependent variable. In contrast, six macroeconomic variables are considered as the explanatory variables from the major markets that coordinate the macroeconomic activities. Industrial Production Index (IPI) from the product market, Broad Money Supply (M2) and Call Money Rate (CM) from the money market, Crude Oil Price (OP) from the resources market, Exchange Rate (ER) from the foreign exchange market, and one of the Indian (Bombay) Stock Market Index (SENSEX) from the foreign market are used as independent variables. The study uses monthly data of all the variables covering the period from January 2001 to December 2012 (144 monthly observations) to investigate the semi-strong form of EMH, long run and short run relationship between DSE all-share price index and macroeconomic variables, and impact of macroeconomic variables volatility on the volatility of DSI returns. In addition, daily closing prices of DSI covering the period from 02 January 1993 to 27 January 2013 (4824 daily observations) are used to investigate the weak form of EMH and the level of volatility prevailing in the Bangladesh stock market. The data for this thesis are collected from secondary sources, such as, the central library and official website of Dhaka Stock Exchange, Monthly Economic Trend issued by Bangladesh Bank (BB), and official website of Bombay Stock Exchange. The analysis is done by using the EViews 8.1 econometric software packages.

Quite a lot of methods are adopted in this thesis to investigate various financial issues. The methods are summarized as follows:

- i. Descriptive statistics are used to provide a general understanding of the empirical features of the variables incorporated in this study.
- ii. A nonparametric run test, linear autocorrelation function model, and unit root tests are employed to test the weak form of EMH.
- iii. Unit root tests and cointegration analysis are applied to test the stationarity and multiple long-run relationship respectively.
- iv. Vector Error Correction Model (VECM) is operated to test the short run relationship, short and long run causality, and reconcile SR-LR behavior of the variables.
- v. Granger causality test is used to test the SR causality for the variables which are not cointegrated.
- vi. The outcome of the VAR analysis, i.e., cointegration analysis, VECM and Granger causality test give the clear picture about the semi-strong form of EMH.
- vii. GARCH (p, q) model is carried out to assess the volatility characteristics of stock returns.
- viii. EGARCH (p,q) model is employed to explore the asymmetric volatility of stock returns.
- ix. GARCH-S models are used to examine the impact of macroeconomic variables volatility on the volatility of the DSI return.

### **6.2.1 Descriptive Statistics**

This part of study summarizes the distribution of the variables by some basic statistics. The most basic summary statistics for variables and their probability distribution are described in two parts:

- i. Measures of Central Tendency
- ii. Measures of Variability

### 6.2.1.1 Measures of Central Tendency

Measures of central tendency describe the center of the data. The measures of central tendency allow us to compare two or more distributions pertaining to the same time period or within the same distribution over time. The study covers only mean and median among many measures of location.

#### Mean

The arithmetic mean is the most widely used and extensively reported measures of location. For the raw data, the population mean is the sum of all values in the population divided by the number of values in the population. The mean  $\bar{x}$  is calculated by the following formula:

$$\bar{x} = \frac{\sum x}{n} \quad (6.1)$$

where  $\sum x$  is the sum of  $x$  values in the population and  $n$  is the number of observations in the population.

For grouped data, arithmetic mean may be calculated by applying the following direct method:

$$\bar{x} = \frac{\sum fm}{n} \quad (6.2)$$

where  $m$  is mid-point of various classes,  $f$  is the frequency of each class and  $n$  is the total number of frequencies.

#### Median

Another measure of central tendency is the median. Lind, Marchal and Wathen (2008) define that median is the midpoint of the values after they have been ordered from the smallest to the largest, or the largest to the smallest. In the case of a grouped series, the

median is calculated by the following formula:

$$\text{Median} = L + \frac{\frac{n}{2} - F}{f_m} \times c \quad (6.3)$$

where L is lower limit of the median class, F is sum of frequencies up to but not including the median class,  $f_m$  is frequency of median class and c is width of class interval.

### 6.2.1.2 Measures of Variability

The measures of central tendency do not tell us anything about the spread of the data. For this reason, measures of variability is important to know the distributions of the variables. We use variance, standard deviation, and skewness and kurtosis in order to measure the variability of the distribution. The descriptive statistic part of empirical work of this thesis uses the standard deviation in measuring the variability of the variables.

#### Variance

Variance is the arithmetic mean of the squared deviation from the mean. The variance  $\sigma^2$  is calculated by the following formula:

$$\sigma^2 = \frac{\sum(X - \mu)^2}{N} \quad (6.4)$$

where X is the value of an observation in the population,  $\mu$  is the arithmetic mean of the population and N is the number of observations in the population.

#### Standard Deviation

Standard deviation is the square root of the variance. Standard deviation  $\sigma$  is calculated by the following formula:

$$\sigma = \sqrt{\frac{\sum(X - \mu)^2}{N}} \quad (6.5)$$

### Skewness

Skewness is a measure of symmetry. A distribution can be skewed to the left or to the right. If it is not skewed, then the distribution is said to be symmetric.

Skewness can be defined as:

$$\text{Skewness} = \frac{\sum f(X - \mu)^3}{\sigma^3} \quad (6.6)$$

where  $\mu$  denotes the  $i^{\text{th}}$  central moment.

### Kurtosis

Kurtosis is a measure of whether the data are peaked or flat relative to a normal distribution. It can be estimated as:

$$\text{Kurtosis} = \frac{\mu_4}{\mu_2^2} - 3 \quad (6.7)$$

where  $\mu_2$  and  $\mu_4$  denote the second and fourth central moment respectively.

#### 6.2.2 Autocorrelation Function Test

The autocorrelation test is a parametric test which is used to investigate whether autocorrelation or serial correlation exists or not in the consecutive return of time series DSI data. Serial correlation test, also known as autocorrelation test, measures the correlation coefficient between a series of returns and lagged returns in the same series. The autocorrelation coefficient  $\rho_k$  measures the degree of correlation between the current stock return  $R_t$  and the return separated by  $K$  lags  $R_{t-k}$  (Tsay, 2005). It can be computed as the ratio of the covariance between  $R_t$  and  $R_{t-k}$  to the product of their

standard deviations as:

$$\rho_k = \frac{\text{COV}(R_t, R_{t-k})}{\sigma(R_t)\sigma(R_{t-k})} = \frac{E[(R_t - \mu)(R_{t-k} - \mu)]}{E[(R_t - \mu)^2]} \quad (6.8)$$

A significant positive serial correlation implies that a trend exists in the series, while, a negative serial correlation indicates the existence of reversal in price movements. A return series that is truly random may have a zero serial correlation coefficient. If the stock series practices a random walk, there is no significant serial dependence.

Autocorrelation coefficient at lag k can be estimated as:

$$\widehat{\rho}_k = \frac{\sum_{t=1}^{n-k} [(R_t - \bar{R})(R_{t-k} - \bar{R})]}{\sum_{t=1}^n (R_t - \bar{R})^2} \quad (6.9)$$

where  $\bar{R}$  is the sample mean of stock returns.

The following null and alternative hypothesis are tested:

$H_0$ : DSI returns are not independent (i.e., autocorrelation)

$H_1$ : DSI returns are independent ( i.e., no autocorrelation).

Since the existence of autocorrelation is a very powerful result with regards to weak form of efficiency of EMH, Ljung-Box Q statistics is also used to investigate whether autocorrelation exists or not. The Ljung-Box Q test (Ljung and Box, 1978) is a modification of the original Box-Pierce Q test and can be computed as:

$$Q_k = N(N + 2) \sum_{j=1}^k \frac{\widehat{\rho}_j^2}{N - j} \quad (6.10)$$

where  $\widehat{\rho}_j$  is the sample autocorrelation coefficient at lag j.



### 6.2.3 Run Test

The Run test, also called Geary test, is one of the usual non-parametric tests for serial dependence of time series. In Run test, the number of sequences of consecutive positive and negative returns is tabulated and compared against its sampling distribution under the random walk hypothesis (Campbell et al., 1997; Gujrati, 2003). Zarour contributes to make it very clear with an example as follows:

‘A particular sequence of 10 returns may be represented by 1001110100, containing three runs of 1s (of length 1, 3 and 1 respectively) and three runs of 0s (of length 2, 1 and 2 respectively), thus six runs in total. In contrast, the sequence 0000011111 contains the same numbers of 0s and 1s, but only 2 runs. Moreover, the runs test determines whether successive price changes are independent. Unlike its parametric equivalent the serial correlation test, the runs test does not require returns to be normally distributed. A run is a sequence of successive price changes with the same sign, if the returns series exhibit greater tendency of change in one direction, the average run will be longer and the number of runs fewer than that generated by random process.’ (2006, p. 108)

So, a run is outlined as the repeated occurrence of the same value or category of a variable. It is indexed through parameters, which are the type of the run and the length. Stock price runs can be positive, negative, or have no change. The length is how steadily a run type occurs in succession. Under the null hypothesis that successive outcomes are unbiased, the total expected number of runs is distributed as normal with the following mean:

$$\mu = \frac{N(N+1) - \sum_{i=1}^3 n_i^2}{N} \quad (6.11)$$

and the following standard deviation:

$$\sigma_{\mu} = \left[ \frac{\sum_{i=1}^3 \left[ \sum_{i=1}^3 n_i^2 + N(N+1) \right] - 2N \left( \sum_{i=1}^3 n_i^3 - N^3 \right)}{N^2(N+1)} \right]^{\frac{1}{2}} \quad (6.12)$$

where  $N$  is the total number of return observations and  $n_i$  is number of runs of type  $i$ .

The standard normal  $Z$ -statistic ( $Z = (R - \mu) / \sigma_{\mu}$ ) is carried out to test of serial dependence by comparing the actual number of runs in the price series to the expected number  $\mu$ .

The null hypothesis is:  $H_0 : E(\text{runs}) = \mu$ .

When the actual number of runs exceeds (falls below) the expected runs, a positive (negative)  $Z$  value is obtained. Positive (negative)  $Z$  value indicates negative (positive) serial correlation in the return series.

#### 6.2.4 Unit Root Test

The determination of the order of integration of variables is essential while applying regression models or cointegration techniques. Examinations that may verify the order of integration are referred to as unit root tests. Ahead of using the time series data within the models, it is necessary to test stationarity of the data, since the time series properties of the economic variables can strongly influence the outcome of the estimation.

A data series is said to be non-stationary if its first three moments, namely mean, variance and covariance are not constant over time. If it moves away from its mean value then unit root may exist in it. Whereas if a time series is stationary, then it comes back to mean value after going up or down, then no unit root may exist in it. Non-stationary data would guide to mistakenly predict that variables are related when actually they are not. Granger and Newbold (1974) argue that the regression result of such non-stationary data may become spurious. Non-stationary data can also be made stationary via differentiating. The process might need second or third or even more differencing depending upon the nature of the data. The cointegration analysis requires the variables which must be integrated in the same order. A series is integrated in order of  $d$ ,  $I(d)$ , if it should be differenced 'd' times to turn into stationary. If a variable

becomes into stationary after differencing once it is mentioned as integrated order 1, I(1).

The time series move either upwards or downwards with or without trend are known as random walks. Unit root is a necessary condition for a random walk. Three regression models without intercept and trend, intercept with no trend, and intercept with trend are used in this study to test for unit root. Two extensively operated unit root test, namely Augmented Dickey-Fuller (ADF) and Phillips-Peron (PP) test are used to fulfill the precondition of cointegration analysis for the monthly data series of the variables. Augmented Dickey-Fuller (ADF) and Phillips-Peron (PP) unit root test are also used to examine the weak-form of EMH of DSE using daily DSI data.

#### 6.2.4.1 Augmented Dickey-Fuller (ADF) Test

The ADF is the augmented form of Dickey-Fuller test. This is used for complicated time series data to detect the presence of unit root. The ADF test is performed using the following three equations:

$$\Delta Y_t = \alpha + \beta T + \gamma \Delta Y_{t-1} + \delta_i \sum_{i=1}^m \Delta Y_{t-i} + \varepsilon_t \quad (\text{trend and intercept}) \quad (6.13)$$

$$\Delta Y_t = \alpha + \gamma \Delta Y_{t-1} + \delta_i \sum_{i=1}^m \Delta Y_{t-i} + \varepsilon_t \quad (\text{intercept only}) \quad (6.14)$$

$$\Delta Y_t = \gamma \Delta Y_{t-1} + \delta_i \sum_{i=1}^m \Delta Y_{t-i} + \varepsilon_t \quad (\text{no trend, no intercept}) \quad (6.15)$$

where  $\alpha$  is a intercept (constant),  $\beta$  is the coefficient of time trend  $T$ ,  $\gamma$  and  $\delta$  are the parameters where ,  $\gamma = \rho-1$ ,  $\Delta Y$  is the first difference of  $Y$  series,  $m$  is the number of lagged first differenced term, and  $\varepsilon$  is the error term.

The test for a unit root is conducted on the coefficient of  $Y_{t-1}$  in the regression. The unit root test is carried out formulating null and alternative hypothesis as:

$H_0 : \gamma = 0$  ; unit root present

$H_1 : \gamma < 0$  : no unit root

If the t (tau) statistic is less than the critical t-values, the null hypothesis of a unit root cannot be rejected for the time series and hence, one can conclude that the time series is non-stationary at their levels.

#### 6.2.4.2 Phillips Perron (PP) Test

Phillips and Perron (1988) have developed a non-parametric unit root conception. It is used in time series analysis to test the null hypothesis that a time series is  $I(1)$ . The PP test is modified from Dickey-Fuller test so that serial correlation does no longer affect their asymptotic distribution. The PP test test is performed using the following three equations:

$$\Delta Y_t = \alpha + \beta T + \gamma \Delta Y_{t-1} + \varepsilon_t \quad (\text{trend and intercept}) \quad (6.16)$$

$$\Delta Y_t = \alpha + \gamma \Delta Y_{t-1} + \varepsilon_t \quad (\text{intercept only}) \quad (6.17)$$

$$\Delta Y_t = \gamma \Delta Y_{t-1} + \varepsilon_t \quad (\text{no trend, no intercept}) \quad (6.18)$$

where  $\alpha$  is a constant,  $\beta$  is the coefficient of time trend  $T$ ,  $\gamma$  is the parameter and  $\varepsilon$  is the error term.

Whilst the ADF test addresses lags of  $\Delta Y$  as regressors in the test equation, the PP test makes a non-parametric correction to the t-test statistic. The PP tests correct for any serial correlation and heteroscedasticity in the errors  $\varepsilon_t$  of the test regression by directly modifying the test statistic.

### 6.2.5 Analysis using Vector Autoregression (VAR) Model

Multivariate time series analysis investigates dependence and interactions among a set of variables in multi-values procedure. One of the most robust method of analyzing multivariate time series is the Vector Autoregression (VAR) Model. This is a natural extension of the univariate autoregression (AR) model to the multivariate case (Kozan, 2010). The model has quite a few interesting characteristics that make it especially suited for this research. This section describes the basic models of stationary multivariate time series that can be useful for modeling dynamic co-dependencies among the ‘n’ different time series.

Vector Autoregression is based on multivariate time series analysis and has been developed by Johansen (1988). VAR is used to find the relationship between various variables by taking into account the feedback by other variables. Estimation based on VAR contains endogenous variables in adding exogenous variables in the equation, making it an important tool for multivariate analysis. In univariate time series analysis, the first order autoregressive process, called AR(1) describes how a variable’s current value is related to past values, i.e.,

$$X_t = \phi X_{t-1} + \varepsilon_t \quad , \varepsilon_t \sim \text{IID}(0, \sigma^2) \quad (6.19)$$

But, in advance analysis, the variance is not just dependent on past values of itself, but additionally of past values of other variables. This is why, VAR model of multivariate version is developed. As in Enders (2004), an n-equation VAR can be represented by:

$$\begin{bmatrix} X_{1t} \\ X_{2t} \\ \vdots \\ X_{nt} \end{bmatrix} = \begin{bmatrix} A_{10} \\ A_{20} \\ \vdots \\ A_{n0} \end{bmatrix} + \begin{bmatrix} A_{11}(L) & A_{12}(L) & \cdot & A_{1n}(L) \\ A_{21}(L) & A_{22}(L) & \cdot & A_{2n}(L) \\ \cdot & \cdot & \cdot & \cdot \\ A_{n1}(L) & A_{n2}(L) & \cdot & A_{nn}(L) \end{bmatrix} \begin{bmatrix} X_{1t-1} \\ X_{2t-1} \\ \cdot \\ X_{nt-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \cdot \\ \varepsilon_{nt} \end{bmatrix} \quad (6.20)$$

where  $A_{i0}$  = the parameters representing intercept terms,  $A_{ij}(L)$  = the polynomials in the lag operator L. The individual coefficients of  $A_{ij}(L)$  are denoted by  $a_{ij}(1), a_{ij}(2), \dots$ . Since all equations have the same lag length, all the polynomials  $A_{ij}(L)$  are of the same degree. The terms  $\varepsilon_{it}$  are white-noise disturbances that may be correlated. Again designate the variance/covariance matrix by  $\Sigma$ , where the dimension of  $\Sigma$  is (n xn).

### **6.2.5.1 Cointegration Analysis**

We introduce a multivariate time series model for the dynamic co-dependencies that are frequently found in economics. In many time series, integrated processes are considered together and they form equilibrium relationships. This leads to the concept of cointegration. Cointegration has emerged as an impressive method for investigating common trends in multivariate time series and provides a sound methodology for modeling long and short run dynamics in a system (Alexander, 2001). A set of I(1) series is termed cointegrated if there is a linear combination of these series that is stationary. The idea of cointegration is a robust one because it lets us to explain the existence of an equilibrium or stationary relationship among two or more time series, each of which is individually non stationary (Banerjee et al., 1993).

Cointegration is a three-step procedure:

- i. First step of this procedure comes to a test of stationarity. The order of integration of the variables can be envisioned using ADF and PP unit root checks which have discussed earlier.
- ii. The second step of this process involves the cointegration analysis to determine whether the time series of the selected variables display an equilibrium process in a linear combination. For this purpose of finding a long run (LR) relationship among variables, the Johansen (1990) method of multivariate cointegration is employed.
- iii. The third step of this process be relevant to Vector Error Correction Model (VECM). If there is at least one cointegrating relationship among the variables, then long run and short run causal relationship of variables can be determined by estimating the Vector Error Correction Model (VECM). The Granger causality test are then carried out for the variables which are not cointegrated.

#### **6.2.5.1.1 The Johansen Methodology**

Engle and Granger (1987) suggest a two-step procedure for testing the hypothesis of cointegration using ordinary least square (OLS) method. Later, Johansen (1988 and

1991); Johansen and Juselius (1990) introduce an alternative approach to test for cointegration. The Johansen and Juselius method allows to avoid some drawbacks existing in the Engle-Granger's approach and test the number of cointegrating relations directly (Kozhan 2010).

Johansen and Juselius (1990) cointegration approach based the on VAR model is applied to examine the long run relationship that may exist among representative variables. The Johansen and Juselius (JJ) approach of maximum likelihood estimation technique do not split variables between dependent and independent as all the variables are treated as endogenous variables of the VAR models. The JJ approach can be expressed mathematically as:

$$Y_t = \alpha + A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_p Y_{t-p} + \varepsilon_t \quad (6.21)$$

where  $Y_t$  is a vector containing  $n$  variables of  $I(1)$  at time  $t$ ,  $\alpha$  is an  $(n \times 1)$  vector of constants,  $A_p$  is an  $(n \times n)$  matrix of coefficients,  $p$  is the maximum lag included in the model and  $\varepsilon_t$  is an  $(n \times 1)$  vector of error terms.

As in Enders (2004), Equation (6.21) can be written in the form of the error correction model assuming cointegration of order  $p$  as:

$$\Delta Y_t = \alpha + (A_1 - I)Y_{t-1} + A_2 Y_{t-2} + \dots + A_p Y_{t-p} + \varepsilon_t \quad (6.22)$$

or in a final broad form as:

$$\Delta Y_t = \alpha + \Gamma_1 \Delta Y_{t-1} + \dots + \Gamma_{p-1} \Delta Y_{t-p+1} + \Pi Y_{t-p} + \varepsilon_t \quad (6.23)$$

Where,  $\Gamma_i = (A_1 + A_2 + \dots + A_{p-i} - I)$  represents the dynamics of the model in the short run. In Equation 6.23,  $\Pi = (A_1 + A_2 + \dots + A_p - I)$  represents the long run relationship among the variables included in the vector  $Y_t$ , and  $I$  is the identity vector. The key idea of the JJ approach is to determine the rank of the matrix  $\Pi$ , which represents the number of independent cointegration vectors.

Johansen (1988) suggests two test statistics named trace and eigenvalue test statistic for estimating the number of cointegrating vectors or equations. The trace and maximum eigenvalue test are as follows:

$$\lambda_{\text{trace}}(r) = -T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i) \quad (6.24)$$

and

$$\lambda_{\text{max}}(r, r + 1) = -T \ln(1 - \hat{\lambda}_{r+1}) \quad (6.25)$$

where  $T$  is the sample size and  $\hat{\lambda}_i$  is the eigenvalues.

The trace test statistic hypothesizes that:

$H_0 : r \leq n$  (there are at most  $n$  number of cointegrating vectors)

$H_1 : r > n$  (there are at least  $n$  number of cointegrating vectors);

and the eigenvalue test statistic hypothesizes that:

$H_0 : r = n$  (there are exactly  $n$  number of cointegrating vectors)

$H_1 : r = n+1$  (there are exactly  $n+1$  number of cointegrating vectors).

In order to estimate the equation (6.23), an appropriate lag length must be determined. Five different criteria, namely Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criteria (AIC), Schwarz Information Criteria (SIC), and Hannan-Quinn Information Criteria (HQ) can be used to determine the lag lengths used in the VAR. Residual serial correlation LM Test is performed to select appropriate lag lengths for the VAR.



### 6.2.5.2 Vector Error Correction Model (VECM)

Vector Error Correction Model (VECM) is implemented to investigate the long run causality, short run dynamics, and short run to long run dynamic adjustment of a system of cointegrated variables. The unit root tests mentioned before and the JJ approach give a picture about cointegrated variables in the study which must have an error correction system.

Equation (6.22) can be written as a VECM as:

$$\Delta Y_t = \alpha + \sum_{i=1}^{\rho} \Gamma_i \Delta Y_{t-1} + \Pi Y_{t-\rho} + \varepsilon_t \quad (6.26)$$

where  $\Gamma_i = A_1 + A_2 + A_3 + \dots + A_{\rho-1} - I$  represents the dynamics of the model in the short-run and  $\Pi = A_1 + A_2 + A_3 + \dots + A_{\rho} - I$  is the long-run relationship among the variables included in the vector  $Y_t$  and  $I$  is the identity vector.  $\Delta Y_t$  is an  $n \times 1$  vector of variables and  $\alpha$  is an  $(n \times 1)$  vector of constants.  $\Pi$  is the error correction mechanism, which has two components:  $\Pi = \mu\beta'$  where  $\mu$  is an  $(n \times 1)$  column vector representing the speed of the short run adjustment to the long-run equilibrium, and  $\beta'$  is a  $(1 \times n)$  cointegrating vector with the matrix of long run coefficients.  $\Gamma$  is an  $(n \times n)$  matrix representing the coefficients of the short run dynamics. Finally,  $\varepsilon_t$  is an  $(n \times 1)$  vector of white noise error terms, and  $\rho$  is the order of the autoregression.

VECM allows causation to be determined in two ways:

- i. Short run causality is determined throughout the lagged differences of the variables.
- ii. The second channel of causation is long run causation that is determined in the course of the error correction term.

Erdugan (2012) argues that the VECM estimates provide important information about the SR relationship between stock return and macroeconomic variables, while a negative and significant error correction term signifies the speed of adjustment to the

LR equilibrium level. Before the ECM can be modeled, first need to be have cointegration, given that cointegration implies a significant error correction term, cointegration can be viewed as an indirect test of long run causality. In multivariate causality tests, the testing of long run causality between two variables is more problematic, as it is impossible to tell which explanatory variable is causing the causality through the error correction term. It is possible to have evidence of long run causality, but not short run causality and vice versa. Short run causality between DSI and macroeconomic variables is determined using VECM Granger causality/block exogeneity Wald tests.

### 6.2.5.3 The Granger Causality Test

Granger causality test (1969) is employed to investigate the short run linkages among the variables which are not cointegrated by using Johansen technique. Granger causality test provides a result of causation in any meaningful way than correlation. Using this method, the study tests whether the dependent variable affects independent variables or vice versa. This test implies that X causes Y if Y can be better forecast by including past values of X in the model rather than using only Y's past values. The study uses the following models to find out causality of the variables which are not cointegrated by using Johansen technique:

$$X_t = \sum_{i=1}^n \alpha_i X_{t-i} + \sum_{i=1}^n \beta_i Y_{t-i} + \varepsilon_t \quad (6.27)$$

$$Y_t = \sum_{i=1}^n \gamma_i X_{t-i} + \sum_{i=1}^n \delta_i Y_{t-i} + \varepsilon_t \quad (6.28)$$

The null and alternative hypothesis for the equations are as follows:

$H_0$  : X does not Granger cause Y or vice versa

$H_1$  : X does Granger cause Y or vice versa.

### 6.2.6 GARCH Models

Volatility is defined as the degree to which the price of an equity or other financial assets tends to move or fluctuate over a period of time. Volatility modeling is central to finance and it has been one of the most active areas of research in empirical finance and time series econometrics during the past three decades. The common empirical observation is that financial market volatility is time varying and persistent, shows clustering, responds asymmetrically to shocks, and is different across assets, asset classes, and countries (Bollerslev et al., 1992). More specifically, financial time series data show evidence of three common events, namely volatility clustering, leptokurtosis and the leverage effect. Volatility clustering implies that a period of low volatility runs after periods of low volatility. In financial time series, one often observes that big shocks tend to be followed by big shocks in either direction, and small shocks tend to follow small shocks. In order to model such volatility clustering patterns, the ARCH model (Engle, 1982) and the GARCH model (Bollerslev, 1986) allow the variance to depend upon its history. Leptokurtosis means the distribution of financial data to be followed non-normal distribution. Leverage effect or asymmetric volatility implies that volatility rises when stock prices go down and decreases when stock prices go up, i.e., the consequence of bad news on stock market volatility is greater than the consequence tempted by good news (Alshogathri, 2011). One of the most interesting extensions of the ARCH and GARCH models is the asymmetric volatility models that consider the asymmetric response to shocks. This thesis employs GARCH family models to get the answers of final two research questions incorporated in this study because GARCH models give attention to these three common events. The ARCH/GARCH models comprise of two equations. First is the mean equation which captures the linear dependencies in the time series data, and second is the variance equation which captures the volatility.

The Autoregressive Conditional Heteroskedasticity (ARCH) model developed by Engle (1982) in order to account for a time-varying variance that is usually associated with high frequency financial and economic data. He models ARCH (p) as follows:

$$h_t^2 = \omega + \sum_{i=1}^p \alpha_i \varepsilon_{t-i}^2 \quad (6.29)$$

where  $\omega$  and  $\alpha_i$  are the non-negative parameters to ensure that the conditional variance is positive and  $\varepsilon_{t-i}^2$  is the ARCH term which represents the news about volatility from the previous period, measured as the lags of the squared residual.

The number of lag  $p$  is usually determined using the Box-Jenkins approach. We pay no attention to ARCH ( $p$ ) model as the model fits financial time series well only with a large number of lags. For this reason, this study employs an extended version of ARCH model named GARCH model in view of the fact that GARCH is a parsimonious representation of higher order ARCH model. Moreover, Alexander (2001) argues that ARCH models are not often used in financial markets because the simple GARCH models perform better.

The performance of the estimated GARCH models is evaluated by using Ljung-Box test statistics, for instance  $Q(p)$ , and  $Q^2(P)$ . These tests examine the null hypothesis of no autocorrelation and homoscedasticity in the estimated residuals, and squared standardized residuals up to a specific lag respectively. ARCH LM test is also used to test the null hypothesis of no remaining ARCH effects up to a specific order.

#### **6.2.6.1 GARCH (p, q) Model**

Since a large number of lags usually required by the ARCH ( $p$ ) process, Bollerslev (1986) develops an extended version of ARCH ( $p$ ) model named Generalized Autoregressive Conditional Heteroskedasticity (GARCH) where the variances of returns follow an ARMA process. Thus, both Autoregressive and Moving Average components may be included in the variance equation. GARCH( $p,q$ ) models explain variance by two distributed lags, one on past squared residuals to capture high frequency effects or news about volatility from the previous period measured as the lag of the squared residual from mean equation, and second on lagged values of variance itself to capture long term influences. Alexander (2001) argues that it is rarely necessary to use more than a GARCH(1,1) model. The symmetric GARCH ( $p, q$ ) model jointly estimates two equations named the conditional mean equation and the conditional variance equation.

### The Conditional Mean Equation

$$RDSI_t = \mu + \sum_{i=1}^p \alpha_i RDSI_{t-i} + \sum_{j=1}^q \theta_j \varepsilon_{t-j} + \varepsilon_t \quad (6.30)$$

Where  $RDSI_t$  represents the return of DSI.  $RDSI_{t-i}$  and  $\varepsilon_{t-j}$  are the autoregressive and moving average components respectively.  $p$  and  $q$  are the orders of the process.

Depending on the values of  $p$  and  $q$ , we can distinguish four different forms of the mean equation.

- i. When  $p=0$  and  $q=0$ , the mean equation is a random walk model which implies that stock prices cannot be predicted using their past values.
- ii. When  $p>0$  and  $q>0$ , the mean equation is an ARMA( $p,q$ ) process.
- iii. When  $p>0$  and  $q=0$ , the mean equation is an AR( $p$ ) process.
- iv. When  $p=0$  and  $q>0$ , the mean equation is an MA( $p$ ) process.

Using Box Jenkins methodology and Schwarz Information Criteria (SIC), an appropriate mean equation of GARCH ( $p,q$ ) model is formulated.

### The Conditional Variance Equation

The Conditional Variance Equation is the fundamental contribution of the GARCH( $p,q$ ) model and can be written in the following form:

$$\begin{aligned} \varepsilon_t | \Omega_{t-1} &\sim N(0, h_t^2), \\ h_t^2 &= \omega + \sum_{i=1}^p \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^q \beta_j h_{t-j}^2, \\ \omega > 0, \alpha_i, \beta_j &\geq 0 \rightarrow h_t^2 \geq 0, \quad i = 1, \dots, p, \text{ and } j = 1, \dots, q. \end{aligned} \quad (6.31)$$

where  $\Omega_{t-1}$  is the set of all information available at time  $t-1$ ,  $\omega$  is the mean of yesterday's forecast,  $\alpha_i$  is the coefficient of the ARCH term  $\varepsilon_{t-i}^2$  and  $\beta_j$  is the coefficient of the GARCH term  $h_{t-j}^2$ .

A large positive value of  $\alpha_i$  indicates strong volatility clustering is present in the time series, while a large value of  $\beta_j$  indicates that the impact of the shocks to the conditional variance lasts for a long time before dying out, i.e., volatility is persistent.  $\alpha+\beta$  is less than one or very close to one is an indication of a covariance stationary model with a high degree of persistence and long memory in the conditional variance. If  $\alpha+\beta > 1$ , the GARCH model is non-stationary; the volatility eventually explodes to infinity as time goes to infinity, and  $\alpha+\beta=1$  shows a case of a restricted version of the standard GARCH model which is well-known in the literature as the Integrated Generalized Autoregressive Conditional Heteroskedasticity or IGARCH model (Alexander, 2001).

#### 6.2.6.2 EGARCH Model

It is usually observed in stock markets that volatility is higher in a falling market than in a rising market. The symmetric GARCH model cannot capture this leverage or asymmetric effect which has become quite visible in equity markets during the last two decades. The main drawback of the ARCH and GARCH models is their inability to capture the asymmetry or leverage effect in the volatility of financial time series. In order to correct the weaknesses of ARCH and GARCH models, particularly with regard to their failure to address the issue of asymmetric effect in the volatility, the asymmetric volatility model such as EGARCH is proposed.

The first asymmetric GARCH model named EGARCH model developed by Nelson (1991) can explain the existence for asymmetry in volatility. The conditional variance equation of EGARCH (1, 1) model is:

$$\ln h_t^2 = \omega + \alpha|z_{t-1}| + \gamma z_{t-1} + \beta \ln h_{t-1}^2 \quad (6.32)$$

where  $z_{t-1}$  shows the asymmetric impact of positive and negative shocks. The asymmetry term  $\gamma < 0$  implies that negative shocks has a greater impact on volatility rather than the positive shocks. The negative asymmetric term also suggests for leverage effect that negative shocks do obviously have a bigger impact on future volatility than positive shocks of the same magnitude.

### 6.2.6.3 GARCH-S Model

One of the extended versions of GARCH-X model, GARCH-X model is used to examine the impact of each individual macroeconomic variable included in this study on the stock market return volatility. Lee (1994) provides an extension of the standard GARCH model linked to an error-correction model of cointegrated series to the conditional variance equation. This model is known as the GARCH-X model. According to Lee (1994), the GARCH-X model is useful for examining how the short run disequilibrium affects uncertainty in predicting cointegrated series. The conditional variance equation of GARCH-X model can be expressed mathematically as follows:

$$h_t^2 = \omega + \sum_{i=1}^p \alpha_i \varepsilon_{t-1}^2 + \sum_{j=1}^q \beta_j h_{t-j}^2 + \lambda_n Z_{t-1}^2 \quad (6.33)$$

where  $\lambda_n$  measures the effect of short run deviations from the long run relationship of the cointegrated variables.

Alshogathri (2011) uses an extended version of GARCH-X model, named, GARCH-S model in order to examine the impact of individual macroeconomic variable on the stock market return volatility. In this study, we use the GARCH-S model by substituting the first difference of each macroeconomic variable,  $\Delta X_{nt-1}$  as a replacement for  $Z_{t-1}^2$  term. The GARCH-S model can be expressed mathematically as follows:

$$h_t^2 = \omega + \sum_{i=1}^p \alpha_i \varepsilon_{t-1}^2 + \sum_{j=1}^q \beta_j h_{t-j}^2 + \lambda_n \Delta X_{nt-1} \quad (6.34)$$

where S represents  $\Delta X_{t-1}$ , and parameter  $\lambda_n$  is expected to account for the previous impact of the explanatory variables on the movements of the stock returns.

## 6.3 Conclusion

This Chapter discusses the methodological procedures that are applied in this study. Modern econometric methods, such as, autocorrelation analysis, run test, unit root tests, cointegration, vector error correction, Granger causality, GARCH (p,q), EGARCH and GARCH-S models are employed in order to achieve the distinct objectives formulated in Chapter 1.

## Chapter 7

### Empirical Results of Efficiency Tests

#### 7.1 Empirical Results related to Weak-Form of EMH

The weak form of the efficient market hypothesis claims that prices fully reflect the information inherent in the sequence of past prices, and prices have no memory and follow random walk properties. We test the weak form efficiency in the framework of the random walk model using daily all share price index return data of Dhaka Stock Exchange from 02 January 1993 to 27 January 2013 with a total of 4823 daily return observations. As mentioned before, the weak-form efficiency testing procedure is conducted applying both nonparametric tests (Runs test and Phillips-Perron test) and parametric tests (Autocorrelation test and Augmented Dickey-fuller test). This section presents the empirical results of the above mentioned models.

##### 7.1.1 Descriptive Statistics

This subsection provides descriptive statistics for the data keeping in view to check for the normality of the data. One of the basic assumptions of the random walk model is that the distribution of the return series should be normal. Table 7.1 gives a summary of the statistical features of the daily DSI return data. We notice that the average monthly returns are positive over the sample period. However, the average values do not conclusively suggest that the stock market remained profitable in the short term, as we see that the large spread between the minimum and maximum values. The positive skewness values suggest that DSI returns are strongly skewed to the right. The value of skewness and kurtosis of stock return series are not equal to 0 and 3 respectively. So, data are not normally distributed.

The calculated Jarque-Bera statistics and p-values in the Table 7.1 are used to test the null hypothesis for normal distribution i.e.,  $H_0$ : daily distribution of stock market returns is normally distributed. The p-value less than 0.01 at the 1% level of



significance means that the null hypothesis cannot be accepted. Hence, the non-normal frequency distributions of the stock returns deviate from the prior condition of the random walk model.

**Table 7.1: Descriptive Statistics of Daily DSI Returns**

Statistics	Value
Mean	0.046789
Median	0.000757
Maximum	59.90334
Minimum	-24.95818
Std. Dev.	1.844108
Skewness	7.709156
Kurtosis	257.5930
Jarque-Bera	13073409
Probability	0.000000
Observations	4823

### 7.1.2 Results of Autocorrelation Test

Tests for the absence of serial correlation over time between returns are implemented from lag 1 to lag 30 for DSI of DSE. Table 7.2 shows that there is highly significant autocorrelation for all lags at the 1% level for the returns of DSI indices.

To confirm the results, the autocorrelation coefficients of the return series for first differences are also calculated. It also shows that there is highly significant autocorrelation for all lags at the 1% level for the returns of DSI indices for the first differences. The non-zero autocorrelation associated with Ljung -Box Q statistics suggests that the DSI return series does not follow random walk model. So, the serial autocorrelation test reveals that the DSE is not weak form efficient as stock prices do not follow a random walk.

**Table 7.2: Tests for Serial Correlation in Daily DSI Returns of DSE**

Lags	Level			First Differences		
	AC	Q-stat	P-value	AC	Q-stat	P-value
1	0.100	48.204	0.000	-0.435	912.77	0.000
2	-0.017	49.627	0.000	-0.077	941.61	0.000
3	0.005	49.742	0.000	0.002	941.63	0.000
4	0.023	52.377	0.000	0.006	941.81	0.000
5	0.031	57.009	0.000	0.029	945.76	0.000
6	-0.013	57.817	0.000	-0.038	952.71	0.000
7	0.011	58.446	0.000	0.006	952.87	0.000
8	0.025	61.529	0.000	0.012	953.58	0.000
9	0.017	62.977	0.000	-0.015	954.62	0.000
10	0.036	69.149	0.000	0.024	957.48	0.000
15	0.011	74.532	0.000	0.015	972.55	0.000
20	-0.010	77.719	0.000	-0.024	984.10	0.000
25	-0.009	89.812	0.000	-0.016	991.93	0.000
30	-0.006	96.341	0.000	-0.004	996.61	0.000

**7.1.3 Results of the Run Test**

The results of the runs test for DSI return series are reported in Table 7.3. As can be observed from the table, the Z-statistic of the runs test of serial independence is significant at the 1 percent level. The significant negative Z-value for the returns indicates that the actual number of runs is less than the expected number of runs. So, there is a significant positive serial correlation in the return series. The findings are consistent with the preceding findings of autocorrelation test, showing that the Dhaka Stock Exchange does not follow random walk.

**Table 7.3: Results of Runs Test for the DSI**

Return	Observations	N(<=mean)	N(>mean)	Runs	Z	P-value
DSI	4823	2763	2060	1702	-19.4	0

### 7.1.4 Results of the Unit Root Tests

The unit root test (ADF and PP) results of random walk model are presented in Table 7.4. The test results are compared against MacKinnon (1991) critical values for the rejection of the null hypothesis of unit root. The ADF test results clearly reveal that the null hypothesis of unit root is strongly rejected at 1 percent significant level. It specifies that all the return series are stationary, so they do not follow a random walk. The Phillips- Perron tests also give us a more negative t- statistic compared to the critical values calculated at 1 percent level of significance. The results of PP test are consistent with the findings of ADF test as it rejects the null hypothesis of the series being random, suggesting that the market is not weak form efficient.

**Table 7.4: Results of Augmented Dickey-Fuller (ADF) and Phillips-Peron (PP) Test**

Tests	T-Statistics			Remarks
	None	Intercept	Intercept and Trend	
ADF	-62.77181 (-2.565442)	-62.80204 (-3.431524)	-62.79559 (-3.959941)	No Unit Root
PP	-63.20936 (-2.565442)	-63.17421 (-3.431524)	-63.16799 (-3.959941)	No Unit Root

Note: MacKinnon's 1% critical values for the ADF and PP statistics are in brackets.

## 7.2 Empirical Results related to Semi-Strong Efficiency

In the previous section we examine the Weak Form of Market Efficiency on the basis of daily data. In this section we move from daily data into monthly data over a span of 12 years from January 2001 to December 2012 and subsequently examines for possible predictive short run and long run relationships between the stock market indice of the DSE and macroeconomic variables. More precisely, we investigate the semi-strong form of market efficiency using past available public information other than the "histories of past prices". The information set which we use to test the semi-strong form of market efficiency includes domestic and international macroeconomic variables which theoretically should affect stock prices and which investors may take into account for their investment decisions. Monthly data unfortunately may not be as

informative as high frequency data, e.g., daily data, but most of the maroeconomic variables are published in Bangladesh on a monthly basis, thus the examination of the semi-strong form of market efficiency must be performed on monthly data sets.

### 7.2.1 Descriptive Statistics

Table 7.5 presents the summary statistics including mean, minimum and maximum values, standard deviation, kurtosis, skewness, and Jarque-Bera test for data under consideration in their log levels. These statistics make easy to analyze the normality of the variables. We notice that mean and median of broad money supply (M2) are higher than the other variables. Call money rate experiences the large spread between minimum and maximum values compared to other variables.

**Table 7.5: Statistical Features of the Variables in Log Level**

	DSI	IPI	CMR	M2	OP	ER	SENSEX
Mean	7.495254	5.869713	2.034724	12.20954	3.965071	4.189008	9.121045
Median	7.429048	5.874868	2.057955	12.20476	4.053783	4.228001	9.336218
Maximum	8.872790	6.523562	3.512739	13.24618	4.876723	4.423888	9.928623
Minimum	6.409237	5.257495	-0.301105	11.30345	2.863914	3.988984	7.941509
Std. Dev.	0.697252	0.314727	0.536789	0.574774	0.568782	0.110658	0.669115
Skewness	0.213889	0.131375	-0.959810	0.151248	-0.236047	0.122128	-0.456004
Kurtosis	1.797230	1.943085	5.857599	1.788769	1.757916	2.300085	1.656172
Jarque-Bera	9.777888	7.116646	71.10487	9.351510	10.59387	3.297252	15.82580
Probability	0.007529	0.028487	0.000000	0.009318	0.005007	0.192314	0.000366
Observations	144	144	144	144	144	144	144

We can also observe that standard deviations of stock prices of DSE and BSE are higher than the other variables. It means stock prices are more volatile compared to IPI, CMR, M2, OP and ER, while stock prices of DSE is more volatile than BSE. Furthermore, exchange rate and industrial production index are less volatile compared to the other variables during January 2001 to December 2012. The positive skewness values of DSI, IPI, ER and M2 suggest that all share price index, industrial production index and money supply are skewed to the right, while negative skewness values of CMR, OP and SENSEX indicate that the variables are skewed to the left meaning that

the left tails are longer. The kurtosis of macroeconomic variables except call money rate are less than 3, which indicate that the distributions of DSI, IPI, M2, OP, ER and SENSEX are platykurtic. The kurtosis of call money rate is more than 3, which indicate that the distributions CMR is leptokurtic. The value of skewness and kurtosis of stock return series are not equal to 0 and 3 respectively. So, data are not normally distributed. The calculated Jarque-Bera statistics and p-values in Table 7.5 are used to test the null hypothesis for normal distribution (H0: Monthly distribution is normally distributed). The p-value is less than 0.01 meaning that the null hypothesis cannot be accepted at 1% significance level for all the variables except IPI and ER.

**Table 7.6: Mean of the Data in their First Differences**

	$\Delta$ DSI	$\Delta$ IPI	$\Delta$ CMR	$\Delta$ M2	$\Delta$ OP	$\Delta$ ER	$\Delta$ SENSEX
Mean	0.01211	0.00816	0.00182	0.01359	0.01077	0.00279	0.01050
Observations	143	143	143	143	143	143	143

Table 7.6 presents the mean of the data in their first differences. It reveals that money supply and DSI grow at an average rate of 1.3% and 1.2% per month respectively over the period studied. The industrial production, call money rate and exchange rate grow at relatively low rates, while the oil prices and SENSEX grow at an average rate of 1% per month.

**Table 7.7: Correlation Matrix of the Variables**

	DSI	IPI	CMR	M2	OP	ER	SENSEX
DSI	1.000000						
IPI	0.914929	1.000000					
CMR	0.078749	0.152669	1.000000				
M2	0.940434	0.982152	0.113846	1.000000			
OP	0.864637	0.915413	0.192794	0.911382	1.000000		
ER	0.822037	0.949024	0.227648	0.946653	0.918622	1.000000	
SENSEX	0.878303	0.897258	0.074635	0.908850	0.946086	0.896737	1.000000

Although correlation can not indicate the nature of the relationship, Table 7.7

exposes information on the presence and strength of the relationships among the selected 07 variables. It suggests that a positive relationship exists between DSI and macroeconomic variables (IPI, M2, CMR, OP, ER and SENSEX).

### 7.2.2 Unit Root Test Results

To examine the long-run relationship between DSI and macroeconomic variables (IPI, M2, CMR, OP, ER and SENSEX), the series' first need to be tested for stationary property before proceeding for cointegration test. To get a rough idea of time series whether they are stationary or not, graphical depictions of the variables are shown in Figure 7.1. The figure indicates that they are all nonstationary in levels except CMR. Call money rate seems as a stationary data since it is not increased upward as time changes.

**Figure 7.1: Graphical Depictions of the Variables at log level and first difference**

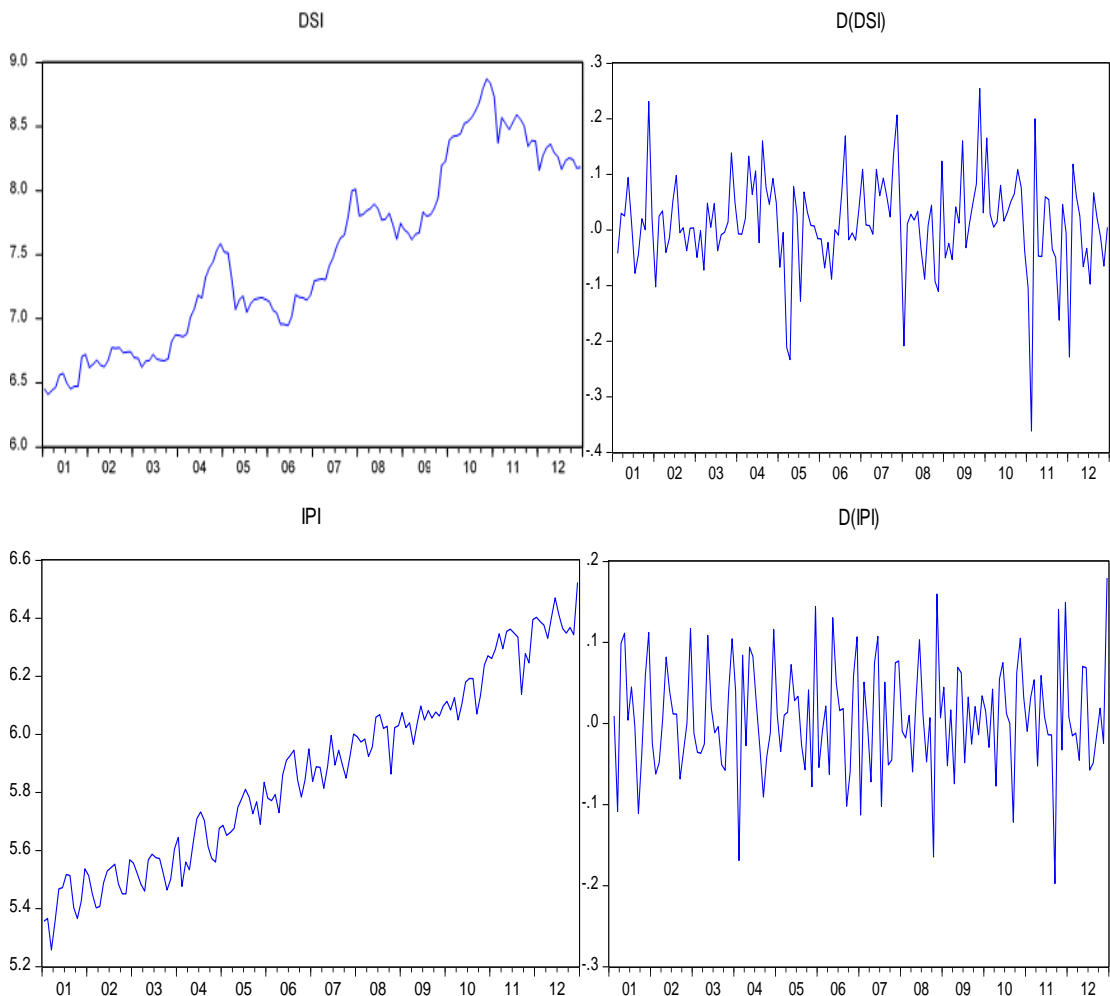


Figure 7.1 on continued

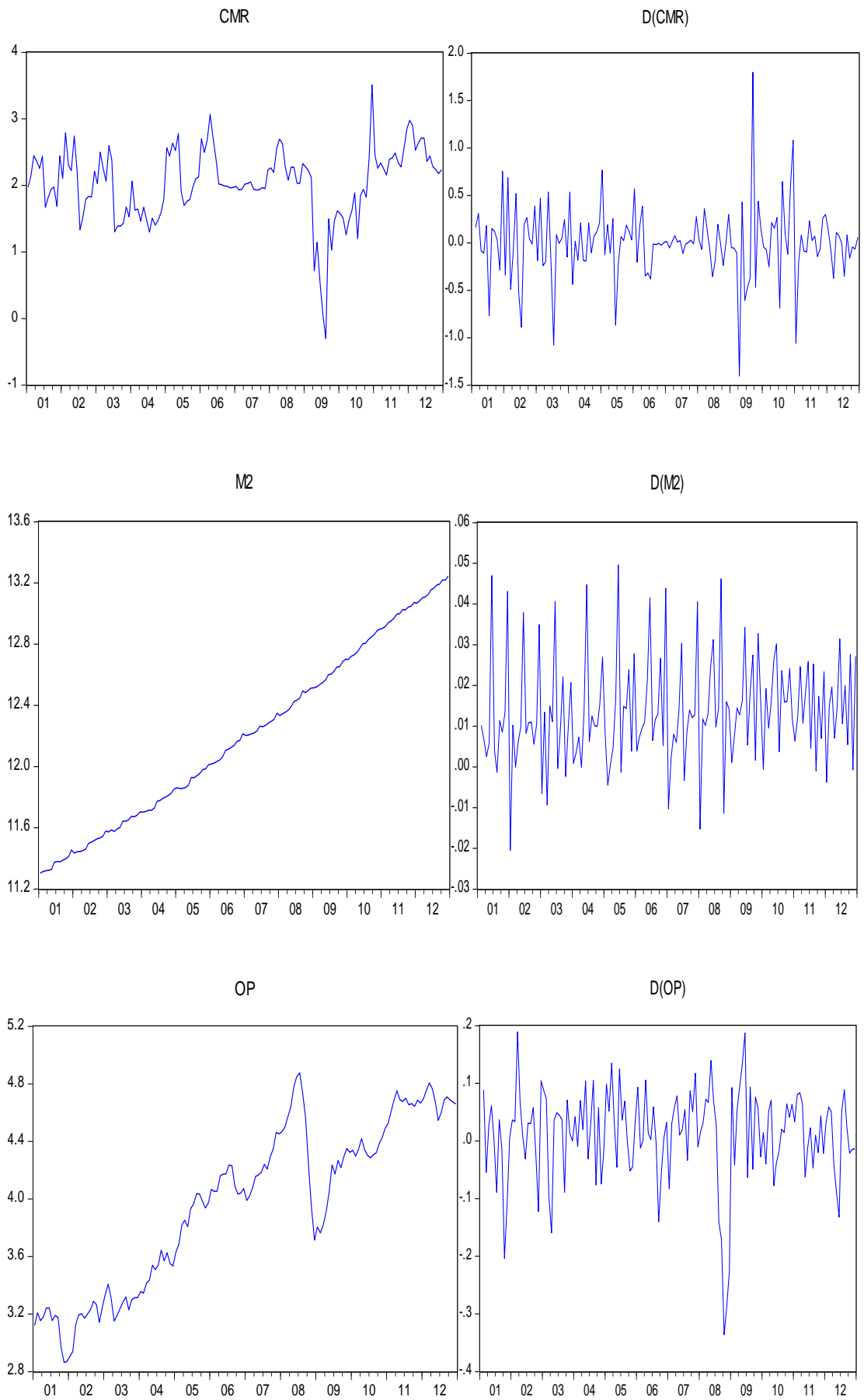
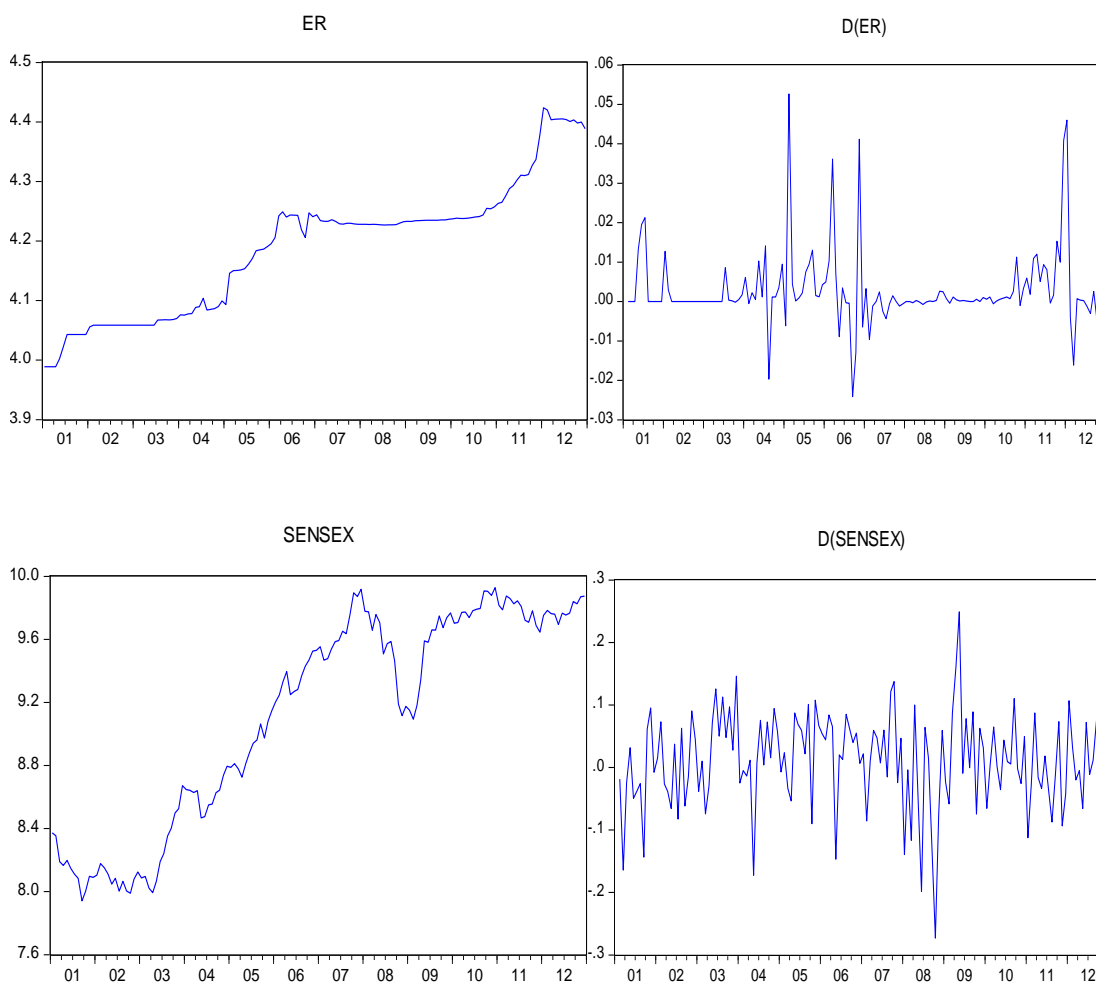


Figure 7.1 on continued



We use two standard tests of stationarity, viz., ADF and PP tests. The tests are applied to the level of the variables and their first differences in logarithmic terms. The null hypothesis of the ADF and PP unit root test is that the series has a unit root, i.e., nonstationary, contrary to the alternative hypothesis of stationary. The second column in Table 7.8 and 7.9 reports the results when a constant or drift or intercept ( $\alpha$ ) term is only included, while the third column shows the results when both a constant ( $\alpha$ ) and a time trend ( $t$ ) are included in the ADF and PP models and the fourth column shows the results when both constant and time trend are excluded. The Augmented Dickey Fuller (ADF) unit root test results are given in Table 7.8. The number of optimal lags for the ADF test is specified by Schwartz Information Criterion (SIC), which is minimized from the maximum 13 (automatic) lags length for DSI, CMR, OP, ER and SENSEX, and 4 and 2 lags length for M2 and IPI respectively. The Phillips-Perron (PP) unit root test results are given in Table 7.9. Automatic bandwidth for PP test is selected according to Newey-West using Bartlett kernel.



**Table 7.8: Results of ADF Unit Root Test**

<b>Variables</b>	<b>Intercept</b>	<b>Trend and Intercept</b>	<b>None</b>
<b>DSI</b>	-1.173890 [0] (0.6848)	-1.796072 [0] (0.7017)	1.554449 [0] (0.9703)
<b>ΔDSI</b>	-10.69421* [0] (0.0000)	-10.69003* [0] (0.0000)	-10.53385* [0] (0.0000)
<b>IPI</b>	-0.021664 [4] (0.9582)	-3.648997** [4] (0.0293)	3.843427 [4] (1.0000)
<b>Δ IPI</b>	-11.00651* [5] (0.0000)	-10.97745* [4] (0.0000)	-11.46614* [3] (0.0000)
<b>CMR</b>	-4.490393* [0] (0.0003)	-4.506215* [0] (0.0021)	-1.024056 [0] (0.2741)
<b>ΔCMR</b>	-14.87360* [0] (0.0000)	-14.82151* [0] (0.0000)	-14.92655* [0] (0.0000)
<b>M2</b>	1.790878 [1] (0.9997)	-2.018255 [1] (0.5861)	11.67875 [1] (1.0000)
<b>ΔM2</b>	-15.79286* [0] (0.0000)	-9.411780* [4] (0.0000)	-2.024706** [4] (0.0415)
<b>OP</b>	-1.286993 [1] (0.6347)	-3.304498 [1] (0.0697)	0.778617 [1] (0.8804)
<b>ΔOP</b>	-8.125477* [0] (0.0000)	-8.096000* [0] (0.0000)	-8.069597* [0] (0.0000)
<b>ER</b>	-0.535896 [0] (0.8795)	-1.694141 [0] (0.7490)	3.400362 [0] (0.9998)
<b>ΔER</b>	-9.946072* [0] (0.0000)	-9.907799* [0] (0.0000)	-9.344927* [0] (0.0000)
<b>SENSEX</b>	-0.662451 [0] (0.8515)	-1.742275 [0] (0.7273)	1.617149 [0] (0.9740)
<b>ΔSENSEX</b>	-10.62320* [0] (0.0000)	-10.58517* [0] (0.0000)	-10.47011* [0] (0.0000)

Notes: \* and \*\* indicate stationary at 1% and 5% levels respectively based on MacKinnon (1996) critical and p-values. First bracket shows p-values and third bracket shows optimal lag.

**Table 7.9: Results of PP Unit Root Test**

<b>Variables</b>	<b>Intercept</b>	<b>Trend and Intercept</b>	<b>None</b>
<b>DSI</b>	-1.198715 [3] (0.6742)	-2.120637 [4] (0.5296)	1.438730 [3] (0.9624)
<b>ΔDSI</b>	-10.68237* [2] (0.0000)	-10.67736* [2] (0.0000)	-10.54011* [3] (0.0000)
<b>IPI</b>	-0.126358 [25] (0.9434)	-7.714912* [25] (0.0000)	6.125673 [23] (1.0000)
<b>Δ IPI</b>	-31.79258* [23] (0.0001)	-33.80554* [23] (0.0001)	-14.79790* [27] (0.0000)
<b>CMR</b>	-4.536034* [6] (0.0003)	-4.548065* [6] (0.0018)	-0.816235 [3] (0.3608)
<b>ΔCMR</b>	-14.87360* [0] (0.0000)	-14.82151* [0] (0.0000)	-14.92655* [0] (0.0000)
<b>M2</b>	4.994883 [61] (1.0000)	-2.045549 [15] (0.5711)	24.10337 [41] (1.0000)
<b>ΔM2</b>	-16.64032* [23] (0.0001)	-33.35425* [73] (0.0001)	-9.670028* [8] (0.0000)
<b>OP</b>	-1.279247 [3] (0.6383)	-2.888404 [4] (0.1694)	1.018861 [3] (0.9185)
<b>ΔOP</b>	-8.125856* [4] (0.0000)	-8.096400* [4] (0.0000)	-8.113155* [3] (0.0000)
<b>ER</b>	-0.535896 [0] (0.8795)	-1.884558 [2] (0.6574)	3.151977 [1] (0.9996)
<b>ΔER</b>	-9.906138* [3] (0.0000)	-9.866987* [3] (0.0000)	-9.345547* [2] (0.0000)
<b>SENSEX</b>	-0.780483 [6] (0.8212)	-2.116466 [6] (0.5319)	1.365865 [6] (0.9566)
<b>ΔSENSEX</b>	-10.70915* [3] (0.0000)	-10.67236* [6] (0.0000)	-10.62217* [6] (0.0000)

Notes: \* indicates stationary at 1% level based on MacKinnon (1996) critical and p-values. First bracket shows p-values and third bracket shows optimal bandwidth.

Considering the results of ADF and PP tests, it is clearly evident that the null hypothesis of a unit root at the level are accepted in all cases for DSI, M2, OP, ER and SENSEX as test statistics are lower than the critical values. It can be noticed that CMR appears to be stationary in the level with intercept, and intercept and trend, while nonstationary in the level without intercept and trend for the both tests are found. If we observe the graphical depictions of CMR in level in Figure 7.1, it is clear that CMR series evolve around the constant mean. Thus, we accept the results without intercept and trend for the both tests, which indicate that CMR has a unit root in level. IPI appears to be stationary in the level with intercept and trend as test statistics are lower than the critical values for both ADF and PP tests, and P-values are significant at 1% level for PP test and 5% level for ADF test. Considering the graphical depiction of IPI in level in Figure 7.1, we consider the intercept term for the IPI series which indicates that IPI has unit root in level.

Therefore, we conclude that all series are nonstationary in levels. Results of the ADF and PP tests provide that all series are stationary in first differences with 1% significance level, while only M2 is stationary in first differences with 5% significance level. So, all the individual series are found to be integrated of order one, i.e.,  $I(1)$ . As a result, the following analysis is conducted under the assumption that all variables are stationary in first differences.

### **7.2.3 Selection of Optimal Lag Lengths for the VAR**

An incorrect specification of Lag length for the VAR model often produces autocorrelation errors. Banerjee et al. (1993) indicate that the number of cointegrating vectors generated by Johansen approach may be sensitive to the number of lags in the VAR model. Henceforth, in this study, we use and check five different criteria namely, Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criteria (AIC), Schwarz Information Criteria (SIC) and Hannan-Quinn Information Criteria (HQ) to determine the optimum lag lengths of the VAR model. Table 7.10 presents the results for each criterion with a maximum of 12 lags. It is clear that AIC, sequential modified LR and FPE criteria stand in favor of 12 lags, 10 lags and 2 lags respectively, while SIC and HQ criteria suggest for only 1 lag.

**Table 7.10: Optimal Lag Lengths of the VAR Model**

Lags	LogL	LR	FPE	AIC	SIC	HQ
0	361.6636	NA	1.09e-11	-5.373691	-5.220816	-5.311570
1	1497.131	2133.302	7.77e-19	-21.83531	-20.61231*	-21.33834*
2	1561.297	113.7487	6.21e-19*	-22.06510	-19.77196	-21.13327
3	1602.536	68.73233	7.09e-19	-21.94751	-18.58425	-20.58084
4	1636.351	52.77153	9.18e-19	-21.71744	-17.28404	-19.91591
5	1667.473	45.26933	1.26e-18	-21.44657	-15.94304	-19.21018
6	1728.193	81.87890	1.14e-18	-21.62413	-15.05047	-18.95290
7	1775.187	58.38703	1.30e-18	-21.59374	-13.94995	-18.48766
8	1834.972	67.93788	1.28e-18	-21.75716	-13.04323	-18.21622
9	1891.975	58.73038	1.38e-18	-21.87841	-12.09436	-17.90262
10	1967.266	69.58658*	1.21e-18	-22.27675	-11.42257	-17.86611
11	2033.666	54.32720	1.32e-18	-22.54039	-10.61607	-17.69489
12	2117.896	59.98190	1.22e-18	-23.07418*	-10.07973	-17.79383

Note: \* indicates lag order selected by the criterion.

### 7.2.3.1 Residual Serial Correlation LM Tests

Residual Serial Correlation LM Test is performed to find out if there is mutual statistical independence for the different error terms. If the residuals do not fulfill the condition, then linear dependencies exist among the residuals and hence, they are said to be autocorrelated. The presence of residual serial correlation makes the result less efficient. Thus, we proceed to conduct LM tests for each suggested lags up to maximum 12 lags. Results are given in Table 7.11. The p-values associated with the Lagrange Multiplier (LM) tests strongly reveal the presence of serial correlation in the estimated residuals generated from VAR (12), VAR (2) and VAR (1) models up to 12 months. Thus, The null hypothesis of no serial correlation in the residuals for the 12 lags and 2 lags suggested by AIC and FPE criteria respectively, and 1 lag suggested by SIC and HQ criteria cannot be rejected based on the p-values of the LM tests. Using 10 lags suggested by sequential modified LR criteria produces no autocorrelation in the VAR model for up to 12 months. So, we accept VAR (10) model for cointegrating analysis.

**Table 7.11: Residual Serial Correlation LM Tests for the VAR Model**

Lags	12 Lags		10 Lags		2 Lags		1 Lag	
	LM-Stat	P-Values	LM-Stat	P-Values	LM-Stat	P-Values	LM-Stat	P-Values
1	72.15516	0.0173	54.41842	0.2759	86.68188	0.0007	133.2469	0.0000
2	49.67929	0.4461	38.82168	0.8510	63.61725	0.0783	70.78582	0.0225
3	65.02715	0.0623	64.06174	0.0729	46.17586	0.5883	62.88920	0.0877
4	77.55298	0.0058	54.49371	0.2735	42.80269	0.7212	47.78010	0.5226
5	54.61724	0.2696	49.35443	0.4589	44.13775	0.6702	58.48318	0.1663
6	57.51628	0.1890	56.47183	0.2159	72.77006	0.0154	104.7207	0.0000
7	56.26140	0.2216	65.00695	0.0625	51.76143	0.3666	58.44499	0.1672
8	52.03360	0.3567	40.34112	0.8062	67.61790	0.0401	73.60007	0.0130
9	55.79510	0.2346	55.17629	0.2526	41.47228	0.7688	58.90166	0.1572
10	31.58263	0.9748	39.62229	0.8282	42.57936	0.7294	50.27771	0.4226
11	48.96123	0.4747	42.80245	0.7212	62.45555	0.0938	72.96807	0.0148
12	52.05812	0.3558	68.22400	0.0360	131.2455	0.0000	173.7853	0.0000

Note: P-values from Chi-square with 49 df.

#### 7.2.4 Results of Long Run Relationship based on Johansen Cointegration Test

Johansen and Juselius (1990) multivariate cointegration test is employed to explore the long run relationship between macroeconomic variables and the stock prices of Bangladesh. After determining the level of integration of the variables and the optimal lag lengths for the VAR model, the final step for the Johansen-Juselius cointegration test gives attention to determine the number of cointegrating vectors. We progress the Johansen cointegration test using the default option of the EViews 8.1 following the suggestions of Agung (2009), which assumes linear trend in the VAR and the cointegrating relationship only has an intercept. Table 7.12 presents particularized results of cointegration test including the trace test (Panel-a) and the maximum eigenvalue test (Panel-b) at the 1% significance level. The trace statistic hypothesizes that there are at most  $r$  number of cointegrating vectors, while the maximum eigenvalue test statistic hypothesizes that there are exactly  $r$  number of cointegrating vectors.

**Table 7.12: Johansen-Juselius Cointegration Test Results**

<b>Panel (a): Unrestricted Cointegration Rank Test (Trace)</b>					
Hypothesized No. of CE(s)		Eigenvalue	Trace Statistic	0.01 Critical Value	P-value**
H <sub>0</sub>	H <sub>1</sub>				
r = 0	r > 0	0.531176	240.3897*	135.9732	0.0000
r ≤ 1	r > 1	0.300807	139.6385*	104.9615	0.0000
r ≤ 2	r > 2	0.212882	92.04733*	77.81884	0.0003
r ≤ 3	r > 3	0.201940	60.21020*	54.68150	0.0023
r ≤ 4	r > 4	0.164116	30.20919	35.45817	0.0448
r ≤ 5	r > 5	0.044755	6.366870	19.93711	0.6522
r ≤ 6	r > 6	0.002081	0.277085	6.634897	0.5986
<b>Panel (b): Unrestricted Cointegration Rank Test (Maximum Eigenvalue)</b>					
Hypothesized No. of CE(s)		Eigenvalue	Max-Eigen Statistic	0.01 Critical Value	P-value**
H <sub>0</sub>	H <sub>1</sub>				
r = 0	r = 1	0.531176	100.7512*	52.30821	0.0000
r = 1	r = 2	0.300807	47.59118*	45.86900	0.0060
r = 2	r = 3	0.212882	31.83713	39.37013	0.0859
r = 3	r = 4	0.201940	30.00101	32.71527	0.0240
r = 4	r = 5	0.164116	23.84232	25.86121	0.0202
r = 5	r = 6	0.044755	6.089785	18.52001	0.6017
r = 6	r = 7	0.002081	0.277085	6.634897	0.5986

Notes: CE(s) represents cointegration equation(s). r indicates the number of cointegrating relationships. \* denotes rejection of the null hypothesis at the 1% level. \*\* indicates MacKinnon-Haug-Michelis (1999) p-values.

A visual inspection of Panel-a in Table 7.12 reveals that the null hypothesis of there are at most 3 cointegrating vectors can be rejected since the  $\lambda_{\text{trace}}$  statistics of 60.21020 is greater than its critical value of 54.68150 at the 1% level of significance. Hence, the trace test indicates 4 cointegrating equations at the 1% level. In contrast, Panel-b in Table 7.12 reveals that the null hypothesis of there is exactly one cointegrating vector can be rejected since the  $\lambda_{\text{max}}$  statistics of 47.59118 is greater than its critical value of 45.86900 at the 1% level of significance. Thus, the maximum eigenvalue test suggests for 2 cointegrating vectors at the 1% level of significance. We consider two cointegrating relationships based on maximum

eigenvalue statistic test following the recommendation of Banerjee et al. (1993) who prefer the maximum eigenvalue statistic test. Moreover, Johansen and Juselius (1990) suggest that maximum eigenvalue test gives better result. It can be taken from the Johansen-Juselius cointegration test that there are at least two cointegrating vectors in the system indicating that there are at least two long run relationship among the variables.

Mukherjee and Naka (1995) argue that in the presence of more than one cointegrating vectors Johansen and Juselius (1990) suggest that the first eigenvalue is the most useful to use in examining the long run relationship between variables in the system. Thus, the first cointegrating vector is normalized on all share price index (DSI). The normalized cointegrating coefficient gives the long run relationship between DSI and macroeconomic variables and results are reported in Table 7.13.

**Table 7.13: Long Run Cointegrating Model**

	Coefficient	Standard Error	t-statistics
DSI	1.00		
Constant	24.44389		
IPI	10.84267*	1.81927	5.95990
CMR	0.034430	0.09594	0.35888
M2	-6.079965*	0.82673	-7.35420
OP	0.744531*	0.29772	2.50075
ER	-4.353431*	1.27146	-3.42395
SENSEX	-0.672024*	0.20290	-3.31218

Note: \* denotes singnificance of variables.

The signs of coefficients are reversed because of the normalization process. The estimation of the equation by cointegration gives the following long run equation:

$$\begin{aligned}
 \text{DSI} = & -24.44 - 10.84 \text{ IPI} - 0.03 \text{ CMR} + 6.07 \text{ M2} - 0.74 \text{ OP} + 4.35 \text{ ER} \\
 & + 0.67 \text{ SENSEX}
 \end{aligned}
 \tag{7.1}$$

Equation 7.1 and Table 7.13 indicate that all the variables included in the model are statistically significant, and long run relationships exist between share prices and macroeconomic variables except call money rate in Bangladesh. In the long run, industrial production index, call money rate and crude oil price have a negative relationship with all share price index of DSE, although the relationship between CMR and DSI is insignificant. On the other hand, money supply, exchange rate and Indian stock prices have a significant long run positive relationship with all share price index of DSE. The result is implying that a 1% increase in IPI, CMR and OP contributes to 10.84%, 0.03% and 0.744% decrease in stock index at Dhaka Stock Exchange of Bangladesh respectively. Besides, a 1% increase in M2, ER and SENSEX contributes to 6.07%, 4.35% and 0.67% increase in stock index at DSE respectively.

The significant negative long run relationship between DSI and IPI (proxied of GDP) is surprising, since it is expected that an increase in industrial production index is positively related to stock price according to economic theory. Previous studies such as, Chen et al. (1986), Naka et al. (1988), Naik and Padhi (2012), Quadir (2012) and Hsing (2013) find a positive relationship between IPI and stock prices. Consistent with the economic theories and empirical studies such as Pilinkus and Boguslauskas (2009), Aurangzeb (2012), Hsing et al. (2012), Eita (2012) and Vejzagic and Zarafat (2013), this research finds a negative relationship between call money rate (proxied for interest rate) and stock prices. We find a significant positive long run relationship between money supply and stock prices in Bangladesh, which is similar to the portfolio theory and empirical studies such as Mukherjee and Naka (1995), Pilinkus and Boguslauskas (2009), Eita (2012), Naik and Padhi (2012), Ray (2012), Hsing et al. (2012), Vejzagic and Zarafat (2013), Muktadir-al-mukit (2013), Naik (2013). The significant negative long run relationship between DSI and OP is not surprising as an increase in the price of crude oil in Bangladesh means lower real economic activity in all sectors that causes stock price to fall. Studies such as Isenmila and Erah (2012) and Ray (2012) argue that there is an inverse relationship between share prices and oil price. Consistent with the flow or traditional approach of exchange rate and studies such as Hsing et al. (2012), Aurangzeb (2012), Sabunwala (2012), Rizeanu and Zhang (2013), we find that there is a significant positive relationship between exchange rate and stock prices in Bangladesh. Two indices namely, DSI and SENSEX have a



significant positive long-term equilibrium relationship, since the two countries (Bangladesh and India) fall in the same geographical region and they maintain a good relationship with commerce and trade. So, Bangladesh is in a process of interaction and integration with international stock markets. This result is also consistent with the previous empirical studies. Empirical studies such as Dekker, Sen and Young (2001), Morelli (2010) and Febrian and Herwany (2007) find integration between the capital markets of different countries. So, the long run relationships reveal from the normalizing cointegrating coefficients are not unexpected except IPI.

Given that the call money rate (CMR) does not significantly contribute to the long run relationship based on t-statistics, we drop CMR from the model and the cointegration test is reestimated. Based on log level data of DSI, IPI, M2, OP, ER, and SENSEX, Table 7.14 presents particularized results of cointegration test including the trace test (Panel-a) and the maximum eigenvalue test (Panel-b). The trace test indicates 4 cointegrating equations at the 1% significance level. In contrast, Panel-b in Table 7.14 shows that the maximum eigenvalue test suggests for 1 cointegrating vector at the 1% level of significance. The first cointegrating vector suggested by maximum eigenvalue test is normalized on all share price index (DSI) that gives the long run relationship between DSI and macroeconomic variables except CMR and this is reported in Equation 7.2.

$$\begin{aligned}
 \text{DSI} = & -32.68 - 15.45 \text{ IPI} + 8.06 \text{ M2} - 0.94 \text{ OP} + 6.75 \text{ ER} + 0.86 \text{ SENSEX} & (7.2) \\
 & (2.13) \quad (0.92) \quad (0.37) \quad (1.62) \quad (0.26) \\
 & [ 7.24] \quad [-8.72] \quad [2.53] \quad [-4.17] \quad [-3.32]
 \end{aligned}$$

Note: Standard Errors are in parentheses and t-statistics are in square brackets.

Equation 7.2 confirms that all variables in the system contribute significantly to the long run relationship with the DSI and also continue to maintain their signs as compared with the Equation 7.1. Thus, results reveals that industrial production index and crude oil price have a significant negative long run relationship with all share price index of DSE, while money supply, exchange rate and Indian stock prices have a significant positive long run relationship with all share price index of DSE. Result implies that a 1% increase in IPI and OP contributes 15.45% and 0.94% decrease in

DSI respectively, while a 1% increase in M2, ER and SENSEX contributes 8.06%, 6.75% and 0.86% increase in DSI respectively.

**Table 7.14: Johansen-Juselius Cointegration Test Results excluding CMR**

<b>Panel (a): Unrestricted Cointegration Rank Test (Trace)</b>					
Hypothesized No. of CE(s)		Eigenvalue	Trace Statistic	0.01 Critical Value	P-value**
H <sub>0</sub>	H <sub>1</sub>				
r = 0	r > 0	0.488877	198.3407*	104.9615	0.0000
r ≤ 1	r > 1	0.255352	109.0784*	77.81884	0.0000
r ≤ 2	r > 2	0.224285	69.86413*	54.68150	0.0001
r ≤ 3	r > 3	0.186336	36.08609*	35.45817	0.0083
r ≤ 4	r > 4	0.050977	8.660466	19.93711	0.3977
r ≤ 5	r > 5	0.012713	1.701615	6.634897	0.1921
<b>Panel (b): Unrestricted Cointegration Rank Test (Maximum Eigenvalue)</b>					
Hypothesized No. of CE(s)		Eigenvalue	Max-Eigen Statistic	0.01 Critical Value	P-value**
H <sub>0</sub>	H <sub>1</sub>				
r = 0	r = 1	0.488877	89.26229*	45.86900	0.0000
r = 1	r = 2	0.255352	39.21428	39.37013	0.0105
r = 2	r = 3	0.224285	33.77804	32.71527	0.0070
r = 3	r = 4	0.186336	27.42563	25.86121	0.0057
r = 4	r = 5	0.050977	6.958851	18.52001	0.4940
r = 5	r = 6	0.012713	1.701615	6.634897	0.1921

Notes: CE(s) represents cointegration equation(s). r indicates the number of cointegrating relationships. \* denotes rejection of the null hypothesis at the 1% level. \*\* indicates MacKinnon-Haug-Michelis (1999) p-values.

### 7.2.5 Results of Long Run Causality and Speed of Adjustment based on VECM

Vector Error Correction Model (VECM) is applied to investigate the long run causality, and short run to long run dynamic adjustment of a system of the six cointegrated variables. Error correction terms contain the long run information since the terms are derived from the long run cointegrating relationship. If the error correction coefficients of error correction terms in all the equations are significant, this suggests the bi-directional long run causality. A negative and significant error

correction term signifies the speed of adjustment to the long run equilibrium level. The error correction coefficient is very important in the error correction estimation as the greater coefficient indicates higher speed of adjustment of the model from the short run to long run, while the coefficient is considered good if the range lies between 0 to -1. The study reduces the lag length by -1 in the lag length for endogenous in the model as we go from the VAR to the VECM. Table 7.15 presents VEC(9) estimates for all share price index, industrial production index, money supply, oil price, exchange rate, and Bombay stock market index.

**Table 7.15: Vector Error Correction Estimates**

<b>Error Correction</b>	<b>D(DSI)</b>	<b>D(IPI)</b>	<b>D(M2)</b>	<b>D(OP)</b>	<b>D(ER)</b>	<b>D(SENSEX)</b>
Coint. Equation	-0.152184*	-0.070110*	-0.004843	0.067345**	0.015175*	-0.034051
Standard Errors	0.04551	0.02470	0.00535	0.03760	0.00493	0.04379
t-statistics	-3.34406	-2.83899	-0.90494	1.79099	3.07669	-0.77750
P-value	0.0009	0.0047	0.3660	0.0739	0.0022	0.4373

Note: \* and \*\* denote significance at 1% and 10% levels respectively.

The long run causal relationship is inferred through the significance of the lagged error correction terms. The result shows that the coefficient of error correction term on the regression with first difference DSI is negative and also significant based on t-statistics and P-value. It indicates that there is a long run causality running from the explanatory variables (IPI, M2, OP, ER, and SENSEX) to the dependent variable (DSI) at the 1% level of significance. This result is in the line with the empirical evidence for the Saudi, China, and Indian stock market by Alshogheathri (2011), Peng et al. (2009) and Naik and Padhi (2012) respectively. The results of the estimated multivariate VECM clearly indicate that the coefficients of error correction terms of the first differenced IPI, ER, and OP equations are statistically significant at the 1%, 1% and 10% levels of significance respectively. It suggests that the long run causality is also directing from DSI to IPI, ER, and OP. The results confirm that there is bi-directional long run causality between DSI and IPI, DSI and ER, DSI and OP in Bangladesh.

The error correction term of first differenced DSI is -0.152184, which implies that the stock index of Dhaka Stock Exchange requires about six and half months to converge into equilibrium after being shocked. Thus, only 15% of the last month's disequilibrium is corrected this month by changes in DSI. The VEC estimates also reveal that the error correction term of first differenced IPI, OP, and ER are significant; however, the coefficients of error correction terms of the first differenced ER and OP equations are not correctly signed. So, adjustment of the disequilibrium of IPI towards a long run equilibrium state takes a long time as the error correction term is too small (0.07). The significant but positive coefficients of error correction terms of ER and OP imply that due to any disturbance in the system, divergence from equilibrium take places and the system becomes unstable. Above and beyond, the coefficients of error correction terms of M2 and SENSEX equations are correctly signed but not significant. Thus, we can conclude that DSI and IPI contribute to adjust any disequilibrium, although there is bi-directional long run causality running between DSI and IPI, DSI and OP, DSI and ER. Moreover, this research finds that all share price index of DSE picks up the disequilibrium quickly and guides the variables of the system back to equilibrium.

#### **7.2.6 Results of Short Run Causality based on VECM Granger Causality/Block Exogeneity Wald Tests**

Short run causality between all share price index of DSE and macroeconomic variables (IPI, M2, OP, ER and SENSEX) is determined with a test on the individual and joint significance of the lagged explanatory variables using VECM Granger causality/block exogeneity Wald tests. Under this system, an endogenous variable can be treated as exogenous. This test detects whether the lags of one excluded variable can Granger cause the dependent variable in the VAR system using the Chi-square (Wald) statistics. Results are reported in Table 7.16.

In the case, where DSI is the dependent variable and IPI, M2, OP, ER, and SENSEX are the joint excluded variables, the Chi-square probability value of the excluded variables is 0.0011 (which is less than 1%). This means that there is a short run Granger causality running jointly from IPI, M2, OP, ER and SENSEX to DSI. The result suggests that the five variables namely, DSI, IPI, M2, OP and ER

are not significantly exogenous, because the p-values of the joint test for each equation of those variables are 0.0011, 0.0000, 0.0195, 0.0015, and 0.0002 respectively. The test fails to reject the null hypothesis of excluding DSI, IPI, M2, OP, and ER from the SENSEX equation. It suggests that DSI, IPI, M2, OP, and ER jointly do not Granger cause SENSEX.

**Table 7.16: Results of the VECM Granger Causality/Block Exogeneity Wald Tests**

<b>Dependent Variable</b>	<b>Excluded</b>	<b>Chi-Square Statistics</b>	<b>Degrees of Freedom</b>	<b>P-value</b>
<b>D(DSI)</b>	D(IPI)	27.13979*	9	0.0013
	D(M2)	11.84370	9	0.2223
	D(OP)	12.59945	9	0.1816
	D(ER)	10.31778	9	0.3254
	D(SENSEX)	17.70702**	9	0.0387
	All	79.79365*	45	0.0011
<b>D(IPI)</b>	D(DSI)	14.72107***	9	0.0989
	All	110.2841*	45	0.0000
<b>D(M2)</b>	D(DSI)	10.47395	9	0.3135
	All	66.68815**	45	0.0195
<b>D(OP)</b>	D(DSI)	6.495771	9	0.6895
	All	78.37936*	45	0.0015
<b>D(ER)</b>	D(DSI)	15.56840***	9	0.0765
	All	86.92780*	45	0.0002
<b>D(SENSEX)</b>	D(DSI)	10.59510	9	0.3045
	All	41.16869	45	0.6350

Note: \*, \*\* and \*\*\* denote significance at 1%, 5% and 10 levels respectively.

In DSI equation, the Chi-square probability value of D(IPI) is 0.0013 (which is less than 1%), while the Chi-square probability value of D(DSI) in IPI equation is significant at 10% level. This means that there is a significant bi-directional short run Granger causality running between DSI and IPI in Bangladesh. There is a unidirectional short run causality running from SENSEX to DSI at 5% level of

significance. DSI also causes ER in the short run at 10% level of significance but the converse is not true. However, the rest of the macroeconomic variables, i.e., M2 and OP individually appear to not have a significant causal relationship with the Bangladesh stock market return in the short run based on the p-values.

Thus, there is a short run Granger causality running jointly from IPI, M2, OP, ER, and SENSEX to DSI, while individually IPI and SENSEX are the leading indicators with respect to stock prices in Bangladesh in the short run. Moreover, stock price index of DSE is a leading indicator with respect to IPI and ER in the short run.

#### 7.2.6.1 Diagnostic Test of the VEC Model

In order to determine the robustness of the model, diagnostic checking of the estimated model has been carried out in terms of conventional multivariate residual-based tests for autocorrelation and heteroskedasticity. At 1% level of significance, the multivariate Lagrange Multiplier (LM) test for autocorrelation indicates the absence of autocorrelation at all lags (Table 7.17), and White's Chi-square test for heteroskedasticity indicates the absence of heteroskedasticity (Table 7.18).

**Table 7.17: Result of the VECM Residual Serial Correlation LM Tests**

Lags	LM-Stat	P-value
1	32.24795	0.6477
2	26.96918	0.8619
3	52.67638	0.0359
4	39.37768	0.3212
5	40.12627	0.2923
6	45.83694	0.1261
7	46.21012	0.1186
8	22.21135	0.9652
9	49.15256	0.0708
10	32.94081	0.6149

Note: P-values from Chi-square with 36 df.

**Table 7.18: Result of VECM Residual Heteroskedasticity Tests (No Cross Terms)**

Chi-square	Degree of Freedom	P-value
2305.671	2310	0.5215

### 7.2.7 Results of Short Run Causality between CMR and DSI based on Granger Causality Tests

This section presents Granger causality test results for the call money rate and all share price index of DSE. Alshogheathri (2011) argues that the Granger causality test is appropriate to examine the short run dynamic relationships between these variables which are not cointegrated. Thus, we conduct pairwise Granger (1969) causality test between DSI and CMR, since they are not cointegrated based on Johansen cointegration test. Using Granger causality model, we test whether the dependent variable (DSI) affects independent variable (CMR) or vice versa. If the p-value is less than 0.05, we can reject the null hypothesis of DSI does not Granger cause CMR or vice versa. Table 7.19 reports the results of Granger causality test (1969) for DSI and CMR based on VAR (1) as all the criteria such as AIC, LR, FPE, SIC and HQ suggest for only 1 lag for the system.

The results reveal that there is an unidirectional short run Granger causality running from CMR to stock market return of DSE, which is significant at 1% level. A p-value of 0.3247 suggests that DSI does not Granger Cause CMR in the short run. However, the short run relationship between CMR and DSI is not consistent with the result of the long run analysis.

**Table 7.19: Granger Causality Test Results**

Null Hypothesis	F-Statistic	P-value	Observations
CMR does not Granger Cause DSI	15.3889*	0.0001	143
DSI does not Granger Cause CMR	0.97688	0.3247	

Note: \* denotes significance at 1% level.

### 7.3 Summary and Remarks

This study is conducted to investigate the market efficiency in the weak form and semi-strong form in Dhaka Stock Exchange. We test the weak form efficiency in the framework of the random walk model using daily all share price index return data of Dhaka Stock Exchange from 02 January 1993 to 27 January 2013. Different tests (Runs test, Phillips-Perron test, Autocorrelation test, and Augmented Dickey-fuller test) have employed to investigate whether past indices returns can predict future returns. All the tests give the same result that DSE does not follow random walk, so DSE is not efficient in the weak form. Hence, there are chances for the technical investors that they can earn the abnormal profit by identifying the trends or patterns in DSE. This finding is consistent with the results of Hassan, Islam and Basher (2002), Nguyen and Ali (2011), Khandoker, Siddik and Azam (2011), Chaity and Sharmin (2012) for the Bangladesh stock market, and other empirical studies such as Gupta and Basu (2007) for the Indian stock market, Gima (2012) for the Nigerian stock market, and Omar et al. (2013) for the Pakistan stock market.

This research uses publicly available macroeconomic variables information and relates it to stock market activity to test the market efficiency in the semi-strong form in Dhaka Stock Exchange based on macrovariable model of APT. Actually, the semi-strong form tests of the EMH have been performed jointly with an equilibrium asset pricing model named APT using monthly data from January 2001 to December 2012. If the macroeconomic variables have no impact on all share price index of DSE, we become able to comment that the Bangladesh stock market is efficient in semi-strong form. In doing so, this study also gets the long run and short run relationship with causality between DSI and macroeconomic variables. The Johansen cointegration tests reveal that industrial production index and crude oil price have a significant negative long run relationship with all share price index of DSE, while money supply, exchange rate, and Indian stock prices have a significant positive long run relationship with all share price index of DSE. The results of VECM indicate that there is a long run causality running from the explanatory variables (IPI, M2, OP, ER, and SENSEX) to the dependent variable (DSI). The error correction term of first differenced DSI is -0.152184, which implies that the stock index of Dhaka Stock Exchange requires about six and half months to converge into equilibrium after being shocked. Thus, only 15%



of the last month's disequilibrium is corrected this month. The VECM results also show that only DSI and IPI contribute to adjust any disequilibrium, although there is a bi-directional long run causality running between DSI and IPI, DSI and OP, DSI and ER. Moreover, this study finds that all share price index of DSE picks up the disequilibrium quickly and guides the variables of the system back to equilibrium. VECM Granger causality/block exogeneity Wald test results show that there is a significant short run Granger causality running jointly from IPI, M2, OP, ER, and SENSEX to DSI. Result also reveals that there is a short run Granger causality running from IPI to DSI at 1% level of significance, and SENSEX to DSI at 5% level of significance. The Granger causality test results reveal that there is a unidirectional short run Granger causality running from CMR to stock market return of DSE at 1% level of significance. Thus, individually IPI, CMR, and SENSEX are the leading indicators with respect to stock prices in Bangladesh in the short run. Moreover, stock price index of DSE is a leading indicator with respect to IPI and ER in the short run. Taking into consideration of the results of Johansen cointegration test, VECM, block exogeneity Wald test, and Granger causality test, it is obvious that all of the selected macroeconomic variables do significantly explain the stock prices of Bangladesh stock market. Since all the macroeconomic variables do significantly explain the stock prices of Bangladesh stock market either in the short run or long run or both, it can be concluded that the Bangladesh stock market is not efficient in semi-strong form.

Thus, all public information are not inherent in current share prices in the stock market of Bangladesh, meaning that both the fundamental analysis based on macroeconomic variables, and the technical analysis based on historical stock prices can be used to achieve superior gains. These results support the common notion that the equity markets in the emerging economies are not efficient.

## Chapter 8

### Empirical Results of Volatility Tests

#### 8.1 Introduction

Volatility is one of the most important concept in the finance and economics as measured by the standard deviation or variance of return. Financial time series usually exhibits a set of peculiar characteristics, i.e., leptokurtosis, volatility clustering, and leverage effects. These characteristics cannot be explained with linear models such as random walk and OLS. The most popular non-linear financial models are the ARCH and GARCH models used for modelling and forecasting volatility. A form of heteroskedasticity that can be encountered in time-series models is the autoregressive conditional heteroskedasticity (ARCH) or generalized ARCH (GARCH). Autoregressive conditional heteroskedasticity (ARCH) models are specifically designed by Engle (1982) to model and forecast variance. Since a large number of lags are usually required by the ARCH model, the study has a preference to operate the GARCH family models.

This Chapter is offered to discuss results of volatility of stock returns in the Bangladesh stock market using two sections. Section 8.2 reports the univariate volatility models in order to estimate the volatility characteristics of stock returns prevailing in the Bangladesh stock market using daily closing stock prices over a span of 20 years, while section 8.3 presents the multivariate volatility models in order to estimate whether the volatility of the macroeconomic variables does have any impact on stock market volatility in Bangladesh using monthly data of the variables over a span of 12 years.

The following steps have been used to analyze the data:

- i. As a first step in analyzing the data, the time series of the variables have been converted into logarithmic returns by taking first differences.
- ii. Some basic descriptive statistics of the variables have reported to get a first impression of the characteristics of the time series used for our analysis.

- iii. We have cared about the stationarity of the data. The ADF and PP unit root test statistics have already reported in subsection 7.1.4 of Chapter 7 for daily data to check for stationarity. A graphical method along with the ADF and PP unit root test statistics have also showed in subsection 7.2.2 of Chapter 7 for monthly data.
- iv. Using Box Jenkins methodology, an appropriate mean equation ARMA (p,q) has been formulated.
- v. Since a large number of lags are usually required by the ARCH model, the study does have a preference to operate the GARCH (p ,q) model developed by Bollerslev (1986).
- vi. GARCH(1,1) model is used as Bollerslev (1986), Engle (1993) and Brook and Burke (1998) argue that standard GARCH (1,1) model is sufficient to capture all of the volatility clustering that is present in the data.
- vii. In order to estimate the level of asymmetric volatility of stock returns in DSE, the EGARCH(1,1) model is used.
- viii. Multivariate GARCH-S(1,1) is used in order to estimate whether the volatility of the macroeconomic variables does have any impact on stock market volatility in Bangladesh.

## **8.2 Results of the Univariate Volatility Models**

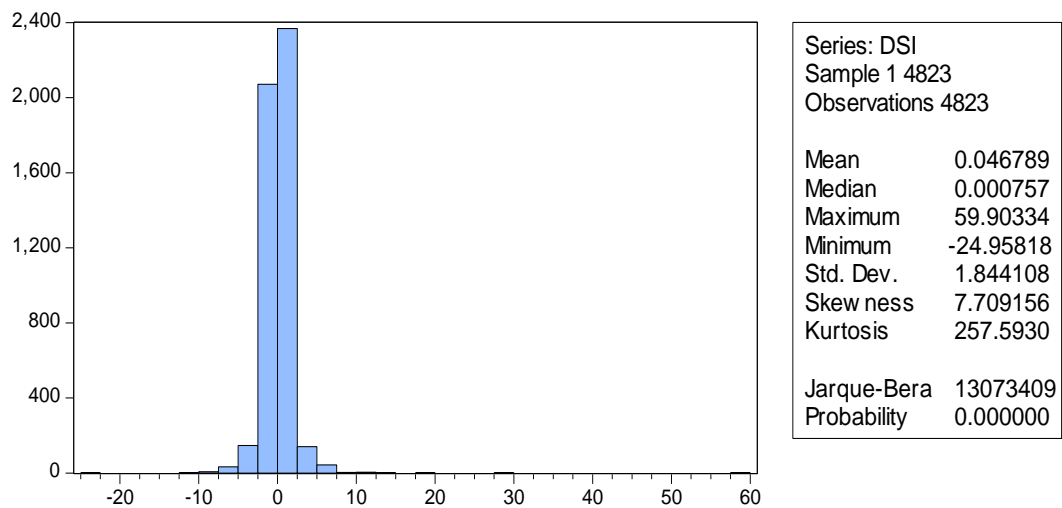
In order to assess the well-known stylized facts of stock returns prevailing in the Bangladesh stock market, daily closing DSI is used over a span of 20 years from 02 January 1993 to 27 January 2013 with a total of 4823 daily return observations. The return series is checked for stationarity in Chapter 7 using ADF and PP tests and results are reported in Table 7.4. The ADF and PP test results clearly reveal that the null hypothesis of unit root is strongly rejected at 1% significance level. It specifies that the return series is stationary in level. Given that, we proceed to examine other statistical properties of DSI returns that are essential for the GARCH models. Figure 8.1 contains basic descriptive statistics with histogram of DSI returns.

The positive skewness value suggests that DSI return series is nonsymmetrically distributed with strongly right skewness meaning frequent small losses and few extreme gains. Positive excess kurtosis of 257.593 of DSI return series means that distribution

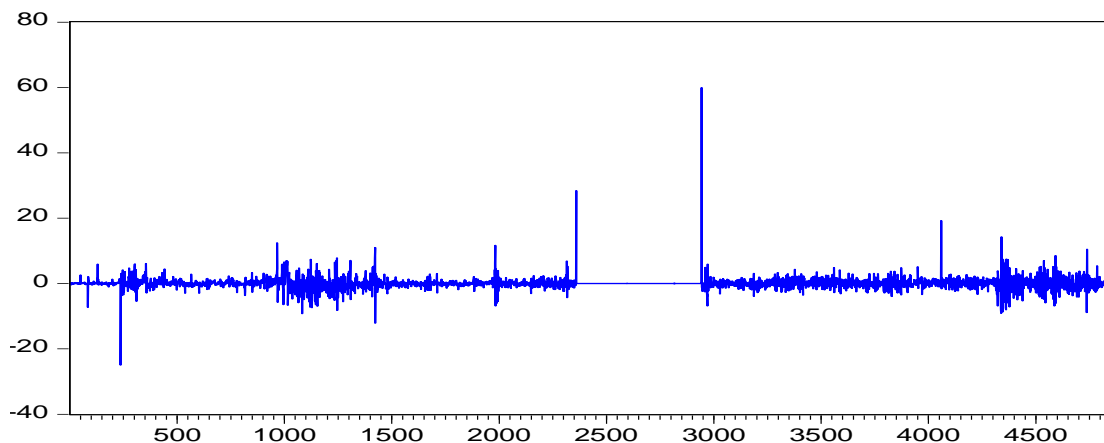
is leptokurtic, i.e., it has fatter tails than a normal distribution where there is higher likelihood of large gains or large losses on an investment. This excess kurtosis also indicates that the volatility of the investment in DSE of Bangladesh is highly volatile. It suggests that the Bangladesh stock market returns exhibit leptokurtosis which is a well-known stylized fact in the finance literature. The calculated Jarque-Bera statistics and p-value in the Figure 8.1 are used to test the following null hypothesis for normal distribution.  $H_0$ : Daily distribution of stock market returns is normally distributed.

The p-value is less than 0.01 means that the null hypothesis cannot be accepted at the 1% level of significance. The departure from normality of the DSE stock returns is also visually supported by looking at the histogram plot in Figure 8.1.

**Figure 8.1: Descriptive Statistics of DSI Returns**



**Figure 8.2: DSI Returns of Dhaka Stock Exchange**



**Table 8.1: Tests for Serial Correlation in Daily DSI Squared Returns of DSE**

Lags	DSI Squared Returns			
	AC	PAC	Q-stat	P-value
1	0.009	0.009	0.3603	0.548
5	0.003	0.003	0.6090	0.988
10	0.001	0.001	0.7600	1.000
15	0.002	0.002	0.8471	1.000
20	-0.000	-0.000	1.1439	1.000
25	0.004	0.004	1.3229	1.000
30	0.001	0.001	2.4026	1.000
36	-0.000	-0.001	2.4199	1.000

Another well known stylized fact in finance literature related to stock market return is volatility clustering. It is noticeable from Figure 8.2 that the period of high (low) volatility in DSE returns is followed by periods of high (low) volatility. This volatility clustering nature of DSI returns may be confirmed by the autocorrelation test that is reported in subsection 7.1.2 in Chapter 7. Table 7.2 in Chapter 7 shows that there is highly significant autocorrelation for all lags from lag 1 up to lag 30 at the 1% level of significance for the returns of DSI on the basis of the Ljung -Box Q statistics. This may be seen as evidence for the presence of ARCH effect or volatility clustering. The Ljung-Box Q-statistics associated with the AC and PAC coefficients of the squared values of DSI returns accept the null hypothesis of no autocorrelation up to 36 lags (Table 8.1). Thus, the volatility clustering nature of DSI returns may not be established by serial autocorrelation test of DSI squared returns, while it may be confirmed by serial autocorrelation test of DSI returns. Krichgassner and Wolters (2007) state that the rejection of the normality test based on Jaque-Bera test gives evidence for the existence of GARCH effects. Since the DSI returns are correlated and not normally distributed, we should follow a GARCH process to model our time series.

### 8.2.1 Modeling the Conditional Mean Equation

In order to determine the conditional mean equation of the GARCH model that best fits the data, 36 Autoregressive Moving Average (ARMA) processes of different orders are

fitted to avoid generating autocorrelation in the squared residuals of the dependent variable of the variance equation. We choose the optimal model based on Schwarz Information Criteria (SIC) as Enders (2010) argues that SIC always selects a more parsimonious, i.e., lower order model compared to the Akaike Information Criteria (AIC). Table 8.2 gives the several combinations of ARMA (p,q) models up to lag 5.

**Table 8.2: SIC for the Mean Equation of DSI Returns**

		MA					
AR	Lag (p,q)	0	1	2	3	4	5
	0	4.063420	<b>4.054660*</b>	4.064897	4.065154	4.064658	4.064282
	1	4.055348	4.056323	4.056337	4.057087	4.056715	4.056231
	2	4.065298	4.056526	4.066505	4.067004	4.066559	4.066144
	3	4.065777	4.057020	4.067228	4.066815	4.067034	4.066642
	4	4.065458	4.056857	4.066945	4.067212	4.066538	4.066462
	5	4.065252	4.056510	4.066710	4.066990	4.066635	4.066220

**Table 8.3: Serial Correlation Tests for the Estimated Residuals of the ARMA(0,1) Model**

Lags	Ljung -Box Q statistics with p-values in parentheses		Breusch-Godfrey Serial Correlation LM Test
	Residuals	Squared Residuals	F-Test (p-values)
1	-	-	1.520500 (0.2176)
4	3.4632 (0.326)	2.6737 (0.445)	2.035008 (0.0868)
6	9.4499 (0.092)	2.7252 (0.742)	1.555406 (0.1560)
8	12.560 (0.084)	2.7900 (0.904)	1.533578 (0.1399)

Given the 36 estimated ARMA (p,q) models, the ARMA (0,1) model provides the lower value of SIC. Thus, ARMA model of order (0,1) is preferred. Moreover, ARMA (0,1) model produces residuals and squared residuals that are free from serial correlation up to 8 orders as indicated by Ljung -Box Q statistics (Table 8.3). It is obvious from the Table 8.3 that Breusch-Godfrey Serial Correlation LM test also accepts the null hypothesis of no serial autocorrelation.

Table 8.4 shows the results for the estimated model in which the p-value associated with the MA(1) coefficient is statistically significant. So, after the return series become stationary, an appropriate mean equation is formulated as ARMA(0,1) using Box Jenkins methodology. The residuals and squared residuals of the ARMA(0,1) model are tested for the presence of autocorrelation. The insignificant correlation among the error term based on Ljung-Box Q statistics and Breusch-Godfrey Serial Correlation LM Test justifies that the mean equation is efficient enough to capture the dynamics of the time series. The ARCH-LM test shown in Table 8.4 presents evidence that the estimated residuals exhibit autoregressive heteroskedasticity (ARCH effect). Thus, we then proceed a symmetric MA(1)-GARCH(1,1) model and an asymmetric MA(1)-EGARCH(1,1) model to estimate the level of volatility prevailing in the Bangladesh stock market.

**Table 8.4: Estimated Optimal ARMA (0,1) Model and ARCH Heteroskedasticity Test**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.046791	0.029183	1.603364	0.1089
MA(1)	0.104706*	0.014323	7.310250	0.0000
<b>ARCH Heteroskedasticity Test</b>				
F-statistic	1.760839**	Prob. F(1,140)		0.0489
Obs*R-squared	21.09887**	Prob. Chi-Square(1)		0.0490
R-squared	0.010463	Mean dependent var		0.046789
Adjusted R-squared	0.010258	S.D. dependent var		1.844108
S.E. of regression	1.834626	Akaike info criterion		4.051973
Sum squared resid	16226.77	Schwarz criterion		4.054660
Log likelihood	-9769.332	Hannan-Quinn criter.		4.052916
F-statistic	50.97670	Durbin-Watson stat		2.003718
Prob(F-statistic)	0.000000	Inverted MA Roots		-.10

Note: \* means significance at 1% level and \*\* means significance at 5% level.

### 8.2.2 Results of the MA(1)-GARCH(1,1) Model

In order to assess the well-known stylized facts of stock returns prevailing in the Bangladesh stock market, the MA(1)-GARCH(1,1) model is used as Bollerslev (1986),

Engle (1993) and Brook and Burke (1998) argue that standard GARCH (1,1) model is sufficient to capture all of the volatility clustering that is present in the data. GARCH models explain variance by two distributed lags, one on past squared residuals to capture high frequency effects or news about volatility from the previous period measured as the lag of the squared residual from mean equation, and second on lagged values of variance itself to capture long term influences. Table 8.5 reports the results of the mean and variance equations of the MA(1)-GARCH(1,1) model for the all share market index returns of Dhaka Stock Exchange.

**Table 8.5: Estimates of the MA(1)-GARCH(1,1) Model**

Variable	Coefficient	Standard Error	Z-Statistic	P-value
<b>Mean Equation</b>				
Constant ( $\mu$ )	0.061298**	0.033432	1.83	0.0667
MA(1) Term $\theta$	0.181711*	0.021650	8.39	0.000
<b>Variance Equation</b>				
Constant ( $\omega$ )	1.570802*	0.077319	20.32	0.000
ARCH (1) Term $\alpha$	0.255310*	0.020023	12.75	0.000
GARCH (1) Term $\beta$	0.340166*	0.032374	10.51	0.000
<b>Diagnostic Fitting</b>				
	Ljung -Box Q statistics with p-values in parentheses		ARCH-LM Test	
Lags	Residuals	Squared Residuals	F-Test (p-values)	
1	-	0.0020 (0.965)	0.001975 (0.964)	
6	10.272 (0.068)	0.0150 (1.000)	0.002504 (1.000)	
12	16.812 (0.114)	0.0241 (1.000)	0.002016 (1.000)	
Log likelihood = -9397.416, AIC= 3.898991, SIC= 3.905710				

Note: \* means significance at 1% level and \*\* means significance at 10% level.

The mean equation of the estimated MA(1)-GARCH(1,1) model shows that the constant  $\mu$  is close to zero and significant at 10% level. The coefficient of MA(1) is highly significant, indicating that the previous period returns play a vital role in determining the current stock market return. All the parameters in the variance equation



( $\omega$ ,  $\alpha$  and  $\beta$ ) have the expected positive signs and more importantly,  $\omega$ ,  $\alpha$  and  $\beta$  are highly significant, meaning that the non-negative conditional variance is met.

Thus, the estimated MA(1)-GARCH(1,1) model gives the impression to capture volatility clustering in our data quite precisely. The sum of the ARCH and GARCH coefficients is less than 1, i.e.,  $\alpha + \beta = 0.60$ , which implies that the unconditional variance of  $\varepsilon_t$  or  $h_t^2$  is stationary. The sum of the ARCH and GARCH coefficients measures the persistence of volatility, and this is not very close to 1 means that a shock to the Bangladesh stock market volatility does not last a long time. Although it takes a fairly moderate time, the volatility process does return to its mean. The significant GARCH term  $\beta$  proves that this is the appropriate model to account volatility on the DSE, and that volatility in the present period also influences volatility in the next period, while the highly significant ARCH term  $\alpha$  indicates a positive relationship between shocks and volatility in the Bangladesh stock market. Table 8.5 also reports that  $\alpha$  is lower than  $\beta$ , which implies that the volatility of the stock market is affected by past volatility more than by related news from the past period. With regard to diagnostic fit presented in Table 8.5, the estimated model satisfies all conditions of the GARCH theory based on Ljung -Box Q statistics and ARCH-LM tests.

### **8.2.3 Results of the MA(1)-EGARCH (1,1) Model**

The basic GARCH model is symmetric and does not capture the asymmetric effect that is inherent in most stock market returns data, which is also known as the leverage effect. In financial economics, the asymmetric or leverage effect refers to the characteristics of time series on asset prices that bad news tends to increase volatility more than good news. In order to estimate the level of asymmetric volatility of stock returns prevailing in the Bangladesh stock market, the MA(1)-EGARCH(1,1) model is used. Nelson (1991) develops Exponential GARCH model which allows the conditional volatility to have asymmetric relation with past data. Table 8.6 reports the results of the mean and variance equations of the MA(1)-EGARCH(1,1) model for the all share price returns of Dhaka Stock Exchange.

**Table 8.6: Estimates of the MA(1)-EGARCH(1,1) Model**

Variable	Coefficient	Standard Error	Z-Statistic	P-value
<b>Mean Equation</b>				
Constant ( $\mu$ )	0.183234*	0.025168	7.28	0.000
MA(1) Term $\theta$	0.179563*	0.017008	10.56	0.000
<b>Variance Equation</b>				
Constant ( $\omega$ )	0.400580*	0.025669	16.61	0.000
EARCH (1) Term $\alpha$	0.338628*	0.019978	16.95	0.000
EARCH-a (1) Term $\gamma$	-0.049494*	0.012724	-3.89	0.000
EGARCH (1) Term $\beta$	0.489489*	0.028807	16.99	0.000
<b>Diagnostic Fitting</b>				
	Ljung -Box Q statistics with p-values in parentheses		ARCH-LM Test	
Lags	Residuals	Squared Residuals	F-Test (p-values)	
1	-	0.0005 (0.982)	0.000853 (1.000)	
6	8.6087 (0.126)	0.0041 (1.000)	0.000689 (1.000)	
12	15.337 (0.168)	0.0102 (1.000)	0.000853 (1.000)	
Log likelihood = -9500.934, AIC=3.942332, SIC= 3.950395				

Note: \* means significance at 1% level.

The mean and variance equations of the estimated MA(1)-EGARCH(1,1) model show that all the parameters are highly significant at 1% level. This is a strong indication for a leverage effect. The positive coefficient of  $ABS(RESID(-1)/\sqrt{GARCH(-1)})$  implies that positive innovations (unanticipated price increases) are more destabilizing than negative innovations. In fact, the asymmetry term  $\gamma$  is negative and highly significant suggesting that negative shock has a greater impact on volatility rather than the positive shocks of the same magnitude. The significance of negative shocks persistence or the volatility asymmetry indicates that investors are more prone to the negative news in comparison to the positive news. This implies that the volatility spillover mechanism is asymmetric. In terms of diagnostic fit presented in Table 8.6, the estimated model satisfies all conditions of the GARCH theory based on Ljung -Box Q statistics and ARCH-LM tests.

### 8.3 Results of the Multivariate Volatility Models

In order to estimate whether the volatility of the macroeconomic variables incorporated in this study have any impact on stock market volatility in Bangladesh, this study uses monthly data of the variables from January 2001 to December 2012. A stationarity test of the variables is already acknowledged in the subsection 7.2.2 in Chapter 7 using the ADF and PP tests. Both the tests suggest that the variables are stationary after first differencing. Provided that, we move forward to inspect other statistical properties of log differenced variables that are crucial for the GARCH family models.

**Table 8.7: Summary Statistics of the Variables in First Differences**

	$\Delta$ DSI	$\Delta$ IP1	$\Delta$ CMR	$\Delta$ M2	$\Delta$ OP	$\Delta$ ER	$\Delta$ SENSEX
Mean	0.012106	0.008161	0.001818	0.013586	0.010773	0.002795	0.010502
Median	0.012596	0.008658	0.005594	0.011605	0.027823	0.000292	0.011157
Maximum	0.254484	0.179682	1.798494	0.049592	0.189260	0.052644	0.248851
Minimum	-0.361591	-0.197327	-1.404510	-0.020457	-0.336056	-0.024133	-0.272992
Std. Dev.	0.086587	0.068034	0.381569	0.012943	0.081403	0.009781	0.075161
Skewness	-0.608937	-0.079928	0.180813	0.566325	-1.229916	2.439100	-0.532343
Kurtosis	5.852268	3.188297	7.509905	3.530499	5.912279	12.82484	4.361091
Jarque-Bera	57.31110	0.363518	121.9672	9.320779	86.58735	716.9329	17.79233
Probability	0.000000	0.833802	0.000000	0.009463	0.000000	0.000000	0.000137
Observations	143	143	143	143	143	143	143

Table 8.7 covers basic descriptive statistics which reveal that money supply and DSI grow a faster rate than other variables with an average of 1.3% and 1.2% per month respectively over the period studied. Looking at the standard deviation of the growth series, it is obvious that CMR remains more volatile than other variables. The returns of the stock markets (DSI and SENSEX) yield both profits and losses to investors, while unconditional standard deviations show that returns of DSI are more volatile than that of SENSEX. The return series of both DSI and SENSEX have asymmetric tails skewed to the left, i.e., -0.61 and -0.53 respectively. This denotes that investors of Bangladesh are likely to earn more negative returns than India. The P-values associated with Jarque-Bera statistics indicate that only differenced data of the industrial production

index is normally distributed. The kurtosis for DSI, CMR, OP, ER and SENSEX are more than 3 suggesting that the returns of DSI and growth of macroeconomic variables exhibit leptokurtosis, a well-known stylized fact in the finance literature.

### 8.3.1 Modeling the Conditional Mean Equation

In order to settle the conditional mean equation of the GARCH model that best fits the monthly return data, 36 Autoregressive Moving Average (ARMA) processes of different orders are fitted to avoid generating autocorrelation in the squared residuals of the dependent variable of the variance equation (Table 8.8). We choose the optimal model based on Schwarz Information Criteria (SIC) as Enders (2010) argues that SIC always selects a more parsimonious, i.e., lower order model compared to the Akaike Information Criteria (AIC).

**Table 8.8: The several combinations of ARMA (p,q) models up to lag 5**

		MA					
Lag (p,q)		0	1	2	3	4	5
<b>AR</b>	0	<b>-2.027651*</b>	-2.004361	-1.993647	-1.994692	-1.994315	-1.994524
	1	-1.998820	-1.967347	-1.965682	-1.966036	-1.964748	-1.964503
	2	-1.981892	-1.958672	-1.947695	-1.949321	-1.948462	-1.948145
	3	-1.975806	-1.952078	-1.941667	-1.998539	-1.941946	-1.941946
	4	-1.973991	-1.949265	-1.939055	-1.941093	-1.966916	-1.939465
	5	-1.966677	-1.941618	-1.931415	-1.933952	-1.931993	-1.957149

Given the 36 estimated ARMA (p,q) models, the ARMA (0,0) model provides the lower value of SIC. Thus, ARMA model of order (0, 0) is preferred. Moreover, it produces residuals and squared residuals that are free from serial correlation up to 12 orders as indicated by Ljung -Box Q statistics (Table 8.9). It is obvious from Table 8.9 that Breusch-Godfrey Serial Correlation LM test accepts the null hypothesis of no serial autocorrelation up to 12 orders. Table 8.10 shows the results for the ARCH heteroskedasticity test. It rejects the null hypothesis of no ARCH in estimated residuals at 10% level of significance.

**Table 8.9: Serial Correlation Tests for the Estimated Residuals of the ARMA(0,0) Model**

	Ljung -Box Q statistics with p-values in parentheses		Breusch-Godfrey Serial Correlation LM Test
Lags	Residuals	Squared Residuals	F-Test (p-values)
1	1.5231 (0.217)	2.8115 (0.094)	1.486329 (0.2248)
2	1.6329 (0.442)	2.8246 (0.244)	0.841273 (0.4333)
4	2.1264 (0.713)	2.9913 (0.559)	0.533130 (0.7116)
6	3.4967 (0.744)	4.2890 (0.638)	0.530774 (0.7841)
8	3.8406 (0.871)	4.9277 (0.765)	0.467548 (0.8772)
10	5.1167 (0.883)	5.8380 (0.829)	0.451461 (0.9179)
12	6.7531 (0.873)	10.293 (0.590)	0.563816 (0.8676)

**Table 8.10: ARCH Heteroskedasticity Test**

F-statistic	2.753764	Prob. F(1,140)	0.0993
Obs*R-squared	2.739224	Prob. Chi-Square(1)	0.0979

So, after the return series become stationary, an appropriate mean equation is formulated without any ARMA term using Box Jenkins methodology. The residuals and squared residuals of the model are tested for the presence of autocorrelation. The insignificant correlation among the error term based on Ljung -Box Q statistics and Breusch-Godfrey Serial Correlation LM Test justifies that the mean equation is efficient enough to capture the dynamics of the time series. The ARCH-LM test shown in Table 8.10 presents evidence that the estimated residuals exhibit autoregressive heteroskedasticity (ARCH effect). Thus, we then proceed an extended version of GARCH-X model named GARCH-S model.

### 8.3.2 Results of the GARCH-S(1,1) Model

GARCH-S model is an extended version of GARCH-M model. GARCH-M model is extended from standard GARCH model by Lee (1994) in order to add an explanatory variable in the GARCH conditional mean or variance equation or both. The extended version of GARCH-M model named GARCH-S model is used to examine the impact

of individual macroeconomic variable on the stock market returns volatility. Table 8.11 to 8.16 report the results of the six mean and variance equations of the GARCH-S (1,1) model for the dependent variable named DSI return of Dhaka Stock Exchange and logged first differences of the independent variables namely, IPI, CMR, M2, OP, ER, and SENSEX respectively.

Table 8.11 presents the GARCH-S (1,1) model estimation to account for the impact of industrial production index volatility on the volatility of Bangladesh stock market returns. The variance equation of the model takes the following form:

$$h_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1}^2 + \lambda \Delta IPI_t \quad (8.1)$$

**Table 8.11: Impact of  $\Delta IPI$  on the Volatility of DSE Returns**

Variable	Coefficient	Standard Error	Z-Statistic	P-value
<b>Mean Equation</b>				
Constant ( $\mu$ )	0.010796*	0.002859	3.776586	0.0002
<b>Variance Equation</b>				
Constant ( $\omega$ )	3.55E-05	9.53E-05	0.372560	0.7095
ARCH (1) Term $\alpha$	-0.060573*	0.018473	-3.279007	0.0010
GARCH (1) Term $\beta$	1.042574*	0.025560	40.78979	0.0000
$\lambda \Delta IPI$	0.018964	0.012573	1.508239	0.1315
<b>Diagnostic Fitting</b>				
	Ljung -Box Q statistics with p-values in parentheses		ARCH-LM Test	
Lags	Residuals	Squared Residuals	F-Test (p-values)	
1	1.0163 (0.313)	0.7284 (0.393)	0.703351 (0.4031)	
6	3.8081 (0.703)	2.0102 (0.919)	0.281798 (0.9447)	
12	6.7853 (0.871)	6.2172 (0.905)	0.639379 (0.8048)	
Log likelihood = 161.2159, AIC= -2.184837, SIC= -2.081241				

Note: \* means significance at 1% level.

The mean equation of Table 8.11 shows that the constant  $\mu$  is close to zero and significant at 1% level. Both the ARCH and GARCH coefficients are significant at 1%

level which indicates that including changes in IPI in the variance equation generates the appropriate model to account volatility on the Bangladesh stock market. The sum of the ARCH and GARCH coefficients is less than 1, i.e.,  $\alpha + \beta = 0.98$ , which implies that the unconditional variance of  $\varepsilon_t$  or  $h_t^2$  is stationary. The sum of the ARCH and GARCH coefficients is nearly close to 1 means that a shock to the Bangladesh stock market volatility lasts a long time. In other words, the time-varying volatility of the DSE returns is highly persistent.

With regard to  $\lambda$  associated with  $\Delta IPI$  suggests that changes in industrial production index (IPI) has an insignificant positive impact on the volatility of the DSE returns over the sample period. With regard to diagnostic fit, the estimated model satisfies all conditions of the GARCH theory based on Ljung -Box Q statistics and ARCH-LM tests.

Table 8.12 presents results of GARCH-S (1,1) model to account the impact of call money rate (proxied for interest rate) volatility on the volatility of DSE returns. The variance equation of the model contains the following form:

$$h_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1}^2 + \lambda \Delta CMR_t \quad (8.2)$$

The coefficient of  $\mu$  in mean equation of Table 8.12 indicates that the constant is significant at 10% level. ARCH coefficient and GARCH coefficient in the variance equation are not significant implying that including changes in the CMR in the variance equation does not generate the appropriate model to account volatility on Dhaka stock exchange. The sum of the ARCH and GARCH coefficients is less than 1 means that the unconditional variance of  $\varepsilon_t$  or  $h_t^2$  is stationary. The sum of the ARCH and GARCH coefficients is 0.25 denotes that a shock to the Bangladesh stock market volatility does not last a long time. An insignificant  $\lambda$  associated with  $\Delta CMR$  suggests that changes in call money rate has an insignificant negative impact on the volatility of the DSE returns over the sample period. In terms of the adequacy of the estimated GARCH-S(1,1) model including changes in the CMR in the variance equation, the Ljung-Box Q-statistics imply no serial correlation of the standardized residuals up to order 12.

Moreover, the  $Q^2$  test cannot reject the null hypothesis of no autocorrelation of the standardized residuals squared up to 12 order. These results are also established by the fact that the estimated model successfully generated residuals that are free of ARCH effects, according to the ARCH-LM test using either the F-statistic or Chi-squared statistic up to order 12.

**Table 8.12: Impact of  $\Delta\text{CMR}$  on the Volatility of DSE Returns**

Variable	Coefficient	Standard Error	Z-Statistic	P-value
<b>Mean Equation</b>				
Constant ( $\mu$ )	0.013873***	0.007570	1.832697	0.0668
<b>Variance Equation</b>				
Constant ( $\omega$ )	0.005569	0.003789	1.469663	0.1417
ARCH (1) Term $\alpha$	0.090421	0.081384	1.111032	0.2666
GARCH (1) Term $\beta$	0.155021	0.510460	0.303688	0.7614
$\lambda\Delta\text{CMR}$	-0.003268	0.002418	-1.351207	0.1766
<b>Diagnostic Fitting</b>				
	Ljung -Box Q statistics with p-values in parentheses		ARCH-LM Test	
Lags	Residuals	Squared Residuals	F-Test (p-values)	
1	3.0134 (0.083)	0.0314 (0.859)	0.030168 (0.8624)	
6	5.4511 (0.487)	1.4624 (0.962)	0.205835 (0.9744)	
12	8.6583 (0.732)	9.9761 (0.618)	0.688986 (0.7593)	
Log likelihood = 150.4960, AIC= -2.034908, SIC= -1.931313				

Note: \*\*\* means significance at 10% levels.

Table 8.13 provides results of GARCH-S (1,1) model to account for the impact of broad money supply volatility on the volatility of Bangladesh stock market returns. The variance equation of the model is expressed as:

$$h_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}^2 + \lambda\Delta M_t \quad (8.3)$$



**Table 8.13: Impact of  $\Delta M2$  on the Volatility of DSE Returns**

Variable	Coefficient	Standard Error	Z-Statistic	P-value
<b>Mean Equation</b>				
Constant ( $\mu$ )	0.023916*	0.004315	5.542317	0.0000
<b>Variance Equation</b>				
Constant ( $\omega$ )	0.007494*	0.001754	4.272350	0.0000
ARCH (1) Term $\alpha$	-0.001544	0.012689	-0.121661	0.9032
GARCH (1) Term $\beta$	0.351592	0.241927	1.453298	0.1461
$\lambda\Delta M2$	-0.204255*	0.027885	-7.324808	0.0000
<b>Diagnostic Fitting</b>				
	Ljung -Box Q statistics with p-values in parentheses		ARCH-LM Test	
Lags	Residuals	Squared Residuals	F-Test (p-values)	
1	0.5878 (0.443)	1.9475 (0.163)	1.895166 (0.1708)	
6	3.9919 (0.678)	3.3859 (0.759)	0.522398 (0.7905)	
12	6.9045 (0.864)	5.9309 (0.920)	0.508632 (0.9057)	
Log likelihood = 153.6948, AIC= -2.079647, SIC= -1.976051				

Note: \* means significance at 1% level.

It is clear from Table 8.13 that coefficients of constants of mean and variance equations are significant at 1% level, while ARCH and GARCH coefficients of variance equation are insignificant. The sum of the ARCH and GARCH coefficients is less than 1 but not close to 1 implies that the unconditional variance of  $\varepsilon_t$  or  $h_t^2$  is stationary and a shock to the DSE volatility does not last a long time. Thus, the time-varying volatility of the DSE returns is moderately persistent.  $\lambda$  associated with  $\Delta M2$  is significant at 1% level implying that changes in money supply has a significant negative impact on the volatility of the DSE returns over the sample period.

In terms of diagnostic fit, the estimated model satisfies conditions of the GARCH theory based on Ljung -Box Q statistics and ARCH-LM tests up to lag 12 as Ljung-Box Q and  $Q^2$  suggest that DSE returns do not suffer from autocorrelation and its squared residuals show no independence. Besides, an ARCH test proves that the model removes conditional heteroskedasticity up to 12 lags.

Including crude oil price volatility in the variance equation, Table 8.14 reports results of the GARCH-S (1,1) model. The variance equation of the model is formulated as:

$$h_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1}^2 + \lambda \Delta OP_t \quad (8.4)$$

**Table 8.14: Impact of  $\Delta OP$  on the Volatility of DSE Returns**

Variable	Coefficient	Standard Error	Z-Statistic	P-value
<b>Mean Equation</b>				
Constant ( $\mu$ )	0.013577*	0.002951	4.600337	0.0000
<b>Variance Equation</b>				
Constant ( $\omega$ )	0.000137*	1.93E-05	7.103191	0.0000
ARCH (1) Term $\alpha$	-0.056372*	0.001337	-42.17511	0.0000
GARCH (1) Term $\beta$	1.048748*	0.000859	1220.195	0.0000
$\lambda \Delta OP$	-0.001431	0.002370	-0.603836	0.5460
<b>Diagnostic Fitting</b>				
	Ljung -Box Q statistics with p-values in parentheses		ARCH-LM Test	
Lags	Residuals	Squared Residuals	F-Test (p-values)	
1	0.8472 (0.357)	0.3581 (0.550)	0.344977 (0.5579)	
6	4.1624 (0.655)	1.9078 (0.928)	0.272119 (0.9491)	
12	7.0066 (0.857)	6.9708 (0.860)	0.638893 (0.8053)	
Log likelihood = 159.8029, AIC= -2.165075, SIC= -2.061479				

Note: \* means significance at 1% level.

The mean and variance equation of Table 8.14 show that the constants  $\mu$  and  $\omega$  are significant at 1% level. Both the ARCH coefficient and GARCH coefficient of the variance equation are also significant at 1% level indicating that including changes in OP in the variance equation frames an appropriate model to account volatility on the Bangladesh stock market. The sum of the ARCH and GARCH coefficients is less than 1, i.e.,  $\alpha + \beta = 0.99$ , which implies that the unconditional variance of  $\varepsilon_t$  or  $h_t^2$  is stationary. The sum of the ARCH and GARCH coefficients is nearly close to 1 means that a shock to the Bangladesh stock market volatility lasts a long time. In other words, the time-varying volatility of the DSE returns is highly persistent. An insignificant  $\lambda$

associated with  $\Delta OP$  suggests that changes in oil price has a little negative impact on the volatility of the DSE returns over the sample period. However, the estimated model satisfies conditions of the GARCH theory based on Ljung -Box Q statistics and ARCH-LM tests up to lag 12.

Table 8.15 submits results of the GARCH-S (1,1) model to account for the impact of exchange rate volatility on the volatility of DSE returns. The variance equation of the model takes the following form:

$$h_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1}^2 + \lambda \Delta ER_t \quad (8.5)$$

**Table 8.15: Impact of  $\Delta ER$  on the Volatility of DSE Returns**

Variable	Coefficient	Standard Error	Z-Statistic	P-value
<b>Mean Equation</b>				
Constant ( $\mu$ )	0.014127***	0.007398	1.909535	0.0562
<b>Variance Equation</b>				
Constant ( $\omega$ )	0.002060***	0.001232	1.672064	0.0945
ARCH (1) Term $\alpha$	0.016659	0.047520	0.350576	0.7259
GARCH (1) Term $\beta$	0.630211*	0.177247	3.555547	0.0004
$\lambda \Delta ER$	0.209106**	0.104604	1.999031	0.0456
<b>Diagnostic Fitting</b>				
	Ljung -Box Q statistics with p-values in parentheses		ARCH-LM Test	
Lags	Residuals	Squared Residuals	F-Test (p-values)	
1	2.0494 (0.152)	0.0151 (0.902)	0.014534 (0.9042)	
6	5.1696 (0.522)	0.9980 (0.986)	0.173186 (0.9836)	
12	10.524 (0.570)	3.7691 (0.987)	0.328390 (0.9827)	
Log likelihood = 152.6171, AIC= -2.064574, SIC= -1.960978				

Note: \*, \*\* and \*\*\* mean significance at 1%, 5% and 10% levels respectively.

The  $\mu$  of mean equation and  $\omega$  of variance equation of Table 8.15 are positive and significant at 10% level. The model reveals that the ARCH coefficient  $\alpha$  is insignificant, while the GARCH term  $\beta$  is significant at 1% level. The sum of the ARCH

and GARCH coefficients is less than one, which implies that the unconditional variance of  $\varepsilon_t$  or  $h_t^2$  is stationary. The sum of the ARCH and GARCH coefficients advises that the time-varying volatility of the DSE returns is moderately persistent. A significant  $\lambda$  associated with  $\Delta ER$  suggests that changes in exchange rate has a positive impact on the volatility of the DSE returns over the sample period. In terms of diagnostic fit, the estimated model satisfies conditions of the GARCH theory based on Ljung -Box Q statistics and ARCH-LM tests up to lag 12.

Table 8.16 provides results of GARCH-S (1,1) model to account for the impact of Indian stock market volatility on the volatility of Bangladesh stock market returns. The variance equation of the model is expressed as:

$$h_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1}^2 + \lambda \Delta \text{SENSEX}_t \quad (8.6)$$

**Table 8.16: Impact of  $\Delta \text{SENSEX}$  on the Volatility of DSE Returns**

Variable	Coefficient	Standard Error	Z-Statistic	P-value
<b>Mean Equation</b>				
Constant ( $\mu$ )	0.012943	0.008779	1.474296	0.1404
<b>Variance Equation</b>				
Constant ( $\omega$ )	0.005075*	0.000495	10.25371	0.0000
ARCH (1) Term $\alpha$	-0.044687*	0.005948	-7.512891	0.0000
GARCH (1) Term $\beta$	0.489262*	0.014324	34.15669	0.0000
$\lambda \Delta \text{SENSEX}$	-0.028655*	0.010141	-2.825793	0.0047
<b>Diagnostic Fitting</b>				
	Ljung -Box Q statistics with p-values in parentheses		ARCH-LM Test	
Lags	Residuals	Squared Residuals	F-Test (p-values)	
1	0.0375 (0.846)	13.272 (0.000)	14.02111 (0.0003)	
6	1.7815 (0.939)	14.392 (0.026)	2.603585 (0.0204)	
12	4.9638 (0.959)	18.540 (0.100)	1.890977 (0.0421)	
Log likelihood = 145.8234, AIC= -1.969559, SIC= -1.865963				

Note: \* means significance at 1% level.

The variance equation of Table 8.16 reveals that both the ARCH coefficient and GARCH coefficient are significant at 1% level. This indicates that including changes in the SENSEX in the variance equation structures an appropriate model to account volatility on the Bangladesh stock market. The sum of the ARCH and GARCH coefficients is away from 1 means that a shock to the Bangladesh stock market volatility does not last a long time, i.e., the time-varying volatility of the DSE returns is moderately persistent.  $\lambda$  associated with  $\Delta$ SENSEX is significant at 1% level implying that Bombay stock index's volatility has a negative impact on the volatility of the DSE returns over the sample period. Thus, the volatility spillover effect is present between Indian and Bangladesh stock markets. However, the estimated model does not satisfy all conditions of the GARCH theory as Ljung-Box  $Q^2$  suggest that DSE returns suffer from autocorrelation up to 6 lags. Moreover, an ARCH test evidences that the model fails to remove conditional heteroskedasticity up to 12 lags.

#### **8.4 Summary and Remarks**

In this Chapter, we investigate the Bangladesh stock return volatility and the asymmetric effects of shocks on return volatility by applying the GARCH-family models using daily DSI return data for the period from 02 January 1993 to 27 January 2013. We find that the DSI returns are correlated and not normally distributed, thus we formulate a GARCH process to model our daily DSI return data. In addition, a MA term of order 1 is preferred for the study using Box Jenkins methodology. In order to estimate the level of volatility clustering of stock returns prevailing in the Bangladesh stock market, the MA(1)-GARCH(1,1) model is used. The results of the estimated MA(1)-GARCH(1,1) model reveal that the stock market of Bangladesh captures volatility clustering. The sum of the ARCH and GARCH coefficients is less than one and not very close to one means that the volatility of Bangladesh stock market is moderately persistent. The results also report that volatility of the stock market of Bangladesh is affected by past volatility more than by related news from the past period. Considering the existence of the asymmetric effects of shocks on the return volatility in the Bangladesh stock markets, we fit the data with the MA(1)-EGARCH(1,1) model. The significance of the parameter  $\gamma$  indicates the existence of the asymmetric shocks or

leverage effect in the Dhaka Stock Exchange. That is, bad news (negative shocks) has a larger impact on DSI return volatility than good news (positive shocks).

The study also sets out to examine the effects that macroeconomic variables have on stock return volatility using monthly data of the variables from January 2001 to December 2012. Using Box Jenkins methodology, an appropriate mean equation is formulated without any ARMA term. We then proceed an extended version of GARCH-X model named GARCH-S model. Findings from the six GARCH-S models lead us to the conclusion that not all macroeconomic variables have similar effects on stock return volatility. It is obvious from the results of six GARCH-S models that including one exogenous macroeconomic variable such as  $\Delta$ API or  $\Delta$ OP or  $\Delta$ SENSEX in the variance equation produces significant  $\alpha$  and  $\beta$  parameters, while including  $\Delta$ ER produces only significant  $\beta$  parameter. Although, the sum of  $\alpha$  and  $\beta$  is less than one in all of the models, the time-varying volatility of the DSE returns is highly persistent including  $\Delta$ API or  $\Delta$ OP in the variance equation. In terms of diagnostic fit, the estimated models satisfy all conditions of the GARCH theory based on the Ljung-Box Q and  $Q^2$  statistics, and ARCH-LM test except  $\Delta$ SENSEX model.

With regard to the impact of economic news, the  $\lambda$  associated with the growth of industrial production index ( $\Delta$ API), changes in the interest rate ( $\Delta$ CMR), changes in crude oil price ( $\Delta$ OP) have no significant impact on the volatility of the Bangladesh stock market returns over the sample period. The implication of these results is that the change of these three macroeconomic variables, i.e.,  $\Delta$ API or  $\Delta$ CMR or  $\Delta$ OP does not explain the volatility of the Bangladesh stock market. There is a significant positive relationship between changes in exchange rate ( $\Delta$ ER) and volatility of DSE returns. This result indicates that with an increase in the exchange rate of 1%, the volatility of the Bangladesh stock market returns is expected to increase by 21%. This result is in the line with the flow or traditional approach, which asserts that a depreciation improves country's external competitiveness and thus its trade balance, and ultimately real output. As a result, the profitability of firms increases with an increase in the exchange rate or depreciation and thus volatility of DSE stock returns increases. This result also implies that international trade plays an important role in Bangladesh and specifically for the companies listed in the stock market. The results also reveal that there is a significant negative relationship between the growth of the broad money

supply ( $\Delta M2$ ) and the volatility of Dhaka stock exchange returns. This shows that with an increase in the broad money supply of 1%, the volatility of the Bangladesh stock market returns is expected to dampen down by 20%. Finally, we find that there is a significant negative relationship between the volatility of Indian stock market ( $\Delta SENSEX$ ) and that of Dhaka stock exchange returns. Result suggests that with an increase in the volatility of Indian stock market of 1%, the volatility of the Bangladesh stock market returns is expected to dampen down by 3%. Thus, the volatility spillover effect is present between Indian and Bangladesh stock market and it agrees with the common notion that the financial markets are highly interdependent with each other because of rapid globalization and liberalization. The implication of these results is that adding  $\Delta ER$  or  $\Delta M2$  or  $\Delta SENSEX$  to the GARCH model provides significant knowledge about the behavior of the DSE volatility. It is concluded that predicting the Bangladesh stock market returns volatility heavily depends on the changes that occur in the domestic and international macroeconomic factors.

## Chapter 9

### Summary and Conclusions

#### 9.1 Introduction

This research explores several issues regarding market efficiency and volatility of the stock market in Bangladesh. The topic is chosen after a review of ample literature exposed a gap in our knowledge about the efficiency and volatility for the stock market in Bangladesh. To the best of the researcher's knowledge, no previous study has examined efficiency and volatility for the stock market simultaneously using the univariate and multivariate econometric models. In Chapter 1, we introduce the research, define the problem and specify the aim and objectives of the research. Theoretical, methodological and empirical studies have undertaken in order to achieve the research objectives. Chapters 7 and 8 represent the empirical results. We investigate the weak form efficiency of EMH and the nature of volatility characteristics of stock returns in the Bangladesh stock market using daily all share price index return data of Dhaka Stock Exchange from 02 January 1993 to 27 January 2013. Furthermore, the study examines the semi-strong form of the EMH based on the macroeconomic variable version of the APT and the volatility of the DSE return in response to the volatility of the macroeconomic variables using monthly data from January 2001 to December 2012. In addition, the short run and long run relationship between macroeconomic variables and aggregate stock prices in Bangladesh have also been determined.

The remainder of this Chapter is structured as follows. Section 9.2 summarizes the empirical findings and underlines the key conclusions that are sketched. Possible opportunities for future research about the stock markets of Bangladesh are discussed in Section 9.3, while Section 9.4 presents the policy suggestions and concludes the Chapter.



## 9.2 Main Findings

This research tests the weak form efficiency of EMH in the framework of the random walk model using daily all share price index return data of Dhaka Stock Exchange from 02 January 1993 to 27 January 2013, employing both nonparametric tests (Runs test and Phillips-Perron test) and parametric tests (Autocorrelation test and Augmented Dickey-fuller test). Results from the empirical analysis suggest that Dhaka Stock Exchange of Bangladesh is not efficient in weak form for the whole period. Different tests have been employed to investigate whether past returns of stock indice predict future returns. The following results are obtained:

- i. The statistical features of the daily DSI return data indicate that the daily distribution of stock market returns is not normally distributed and thus it deviates from the prior condition of the random walk model.
- ii. The serial autocorrelation tests for level and first differences show that the DSE is not weak form efficient as there is highly significant autocorrelation for all lags at the 1% level for the returns of DSI.
- iii. The results of the runs test for DSI return series report that the Z-statistics of the runs test of serial independence is significant at the 1% level. So, the significant positive serial correlation in the return series shows that the Dhaka Stock Exchange does not follow random walk.
- iv. The results of ADF and PP unit root tests reveal that the null hypothesis of unit root is strongly rejected at 1% significant level. Thus the unit root tests suggest that the market is not weak form efficient.

Efficiency tests for the semi-strong form of the EMH have been performed jointly with an equilibrium asset pricing model named ‘macroeconomic variable version APT’ using monthly data from January 2001 to December 2012. In the avenue of exploring semi-strong form of EMH, the research reveals the long run and short run relationship

with causality between stock prices and macroeconomic variables. A special set of local and global macroeconomic variables is chosen from major economic markets considering that the economy of Bangladesh is followed well-known price mechanism of free market economy. Wide ranges of VAR models including the Johansen and Juselius multivariate cointegration test, vector error correction model, Granger causality tests are applied. Summary obtained from the above models are given as follows:

- i. The descriptive statistics show that monthly distributions of the variables are not normally distributed except IPI and ER.
- ii. On the basis of the graphical depictions and results of unit root tests, we conclude that the null hypothesis of unit root at the level are accepted for the variables. ADF and PP tests provide that all series are stationary in first differences at 1% level of significance, while only M2 is stationary in first differences at 5% level of significance. So, all the individual series are realized to be integrated of order one, i.e.,  $I(1)$ .
- iii. We operate five different criteria namely, Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criteria (AIC), Schwarz Information Criteria (SIC) and Hannan-Quinn Information Criteria (HQ) to find out the optimum lag lengths of the VAR model. Results for each criterion with a maximum of 12 lags reveal that AIC, sequential modified LR and FPE criteria propose for 12 lags, 10 lags and 2 lags respectively, while SIC and HQ criteria suggest for only 1 lag. Residual serial correlation Lagrange Multiplier test shows that 10 lags suggested by sequential modified LR criteria produces no autocorrelation in the VAR model for up to 12 months. Hence, we take on VAR (10) model for cointegrating analysis.
- iv. Johansen and Juselius (1990) multivariate cointegration test is applied to investigate the long run relationship between macroeconomic variables and the stock prices of Bangladesh. The trace test indicates for 4 cointegrating

equations, while the maximum eigenvalue test suggests for 2 cointegrating vectors at the 1% level of significance. We take into account two cointegrating relationships based on maximum eigenvalue statistic test following the recommendation of Banerjee et al. (1993) who prefer the maximum eigenvalue statistic test. The first cointegrating vector is normalized on all share price index (DSI). Results of Johansen and Juselius multivariate cointegration test reveal that industrial production index (IPI) and crude oil price (OP) have significant negative long run relationship with all share price index (DSI) of DSE, while money supply (MS), exchange rate (ER), and Indian stock prices (SENSEX) have significant positive long run relationship with all share price index of DSE. All variables included in the model are statistically significant and long run relationships exist between macroeconomic variables and aggregate share prices, except call money rate (CMR) in Bangladesh. Provided that the call money rate (CMR) does not significantly contribute to the long run relationship based on t-statistics, we drop CMR from the model and the cointegration test is reestimated. Based on log level data of DSI, IPI, M2, OP, ER and SENSEX, the maximum eigenvalue test suggests for 1 cointegrating vector at the 1% level of significance. The first cointegrating vector suggested by maximum eigenvalue test is normalized on all share price index (DSI) that gives the long run relationship between DSI and macroeconomic variables except CMR. Result implies that a 1% increase in IPI and OP contributes 15.45% and 0.94% decrease in DSI respectively, while a 1% increase in M2, ER and SENSEX contributes 8.06%, 6.75% and 0.86% increase in DSI respectively.

- v. We apply Vector Error Correction Model (VECM) to investigate the long run causality and short run to long run dynamic adjustment of a system of the six cointegrated variables. Result shows that the coefficient of error correction term on the regression with first difference DSI is negative and also significant based on t-statistics and P-value. It implies that there is a long run causality running from the explanatory variables (IPI, M2, OP, ER, and SENSEX) to the dependent variable (DSI). Results of the estimated multivariate VECM also

show that the coefficients of error correction terms of the first difference IPI and ER equations are statistically significant at the 1 % level, while the error correction term of first difference OP is significant at the 10% level. It suggests that there is bi-directional long run causality between DSI and IPI, DSI and ER, DSI and OP in Bangladesh. The negative and significant error correction term of first differenced DSI implies that the stock index of Dhaka Stock Exchange requires about six and half months to converge into equilibrium after being shocked. Thus, about 15% of the last month's disequilibrium is corrected this month. The VECM results also show that DSI and IPI contribute to adjust any disequilibrium, while DSI picks up the disequilibrium quickly and guides the variables of the system back to equilibrium.

- vi. Short run causality between all share price index of DSE and macroeconomic variables (IPI, M2, OP, ER and SENSEX) is revealed with a test on the individual and joint significance of the lagged explanatory variables employing VECM Granger causality/block exogeneity Wald tests. VECM Granger causality/block exogeneity Wald tests show that there is a significant short run Granger causality running jointly from IPI, M2, OP, ER, and SENSEX to DSI. The test also reveals that individually IPI and SENSEX are the leading indicators with respect to stock prices in Bangladesh in the short run. Furthermore, stock price index of DSE is a leading indicator with respect to IPI and ER in the short run.
- vii. We operate pairwise Granger (1969) causality test between DSI and CMR, since they are not cointegrated based on Johansen cointegration test. The Granger causality test results reveal that there is a unidirectional short run Granger causality running from CMR to stock prices of DSE at 1% level of significance.
- viii. Considering the results of Johansen cointegration test, VECM, block exogeneity Wald test and Granger causality test, it is apparent that all of the

selected macroeconomic variables do significantly explain the stock prices of Bangladesh stock market either in the short run or long run or both. Since macroeconomic variables information are not inherent in current share prices in the stock market of Bangladesh, it can be concluded that the Bangladesh stock market is not efficient in semi-strong form.

This research assesses the volatility characteristics of stock returns using daily closing stock price returns named DSI returns over a span of 20 years from 02 January 1993 to 27 January 2013 with a total of 4823 daily return observations. A symmetric MA(1)-GARCH(1,1) model and an asymmetric MA(1)-EGARCH(1,1) model suggest the following results.

- i. The ADF and PP test results expose that the null hypothesis of unit root is strongly rejected at 1% significance level. It specifies that the return series is stationary in level. Positive excess kurtosis of 257.593 of DSI return series indicates that distribution is leptokurtic that is a well-known stylized fact in the finance literature. The p-value associated with Jarque-Bera statistics show that the daily distribution of stock market returns is not normally distributed.
- ii. Volatility clustering is another well-known stylized fact that is also viewed in DSI return series. This volatility clustering nature of DSI returns is confirmed employing the autocorrelation test that shows that there is highly significant autocorrelation for all lags from lag 1 up to lags 30 at the 1% level of significance on the basis of the Ljung -Box Q statistics. This is seen as evidence for the presence of ARCH effect or volatility clustering. However, the serial autocorrelation test of DSI squared returns does not suggest for volatility clustering nature. Given that the DSI returns are correlated and not normally distributed, we go along with GARCH process to model our time series.
- iii. An appropriate mean equation sets up as MA(1) from 36 combinations of Autoregressive Moving Average (ARMA) using Box Jenkins methodology. Additionally, MA (1) model produces residuals and squared residuals that are

free from serial correlation. The ARCH-LM test presents that the estimated residuals exhibit autoregressive heteroskedasticity (ARCH effect). Thus, we proceed a symmetric MA(1)-GARCH(1,1) model and an asymmetric MA(1)-EGARCH(1,1) model to estimate the level of volatility prevailing in the Bangladesh stock market.

- iv. Results of the estimated MA(1)-GARCH(1,1) model reveal that coefficient of MA(1) in the mean equation is significant at 1% significance level and more importantly, the parameters in the variance equation ( $\omega$ ,  $\alpha$  and  $\beta$ ) hold the expected positive signs and are significant at 1% level. Results also uncover that the stock market of Bangladesh captures volatility clustering. The sum of the ARCH and GARCH coefficients is less than one, i.e.,  $\alpha + \beta = 0.60$ , and not very close to one means that the volatility of Bangladesh stock market is moderately persistent. Results of the model show that  $\alpha$  is lower than  $\beta$ , which implies that the volatility of the stock market is affected by past volatility more than by related news from the past period.
- v. The basic GARCH model is symmetric and does not capture the leverage effect that is inherent in most stock market returns data. Thus, we operate MA(1)-EGARCH(1,1) model with the aim of estimating the level of asymmetric volatility i.e., leverage effect of stock returns in the Bangladesh stock market. Results of the estimated MA(1)-EGARCH(1,1) model show that all the parameters of the mean and variance equations are highly significant at 1% level that is a strong indication for leverage effect. The model also explores that the asymmetry term  $\gamma$  is negative and highly significant meaning that negative shock has a greater impact on volatility rather than the positive shocks of the same magnitude. This implies that the volatility spillover mechanism is asymmetric in Bangladesh stock market.
- vi. The estimated models meet conditions of the GARCH theory based on Ljung - Box Q statistics and ARCH-LM tests up to lags 12 as Ljung-Box Q and  $Q^2$  suggest that DSE returns do not suffer from autocorrelation and its squared

residuals show no independence. Moreover, ARCH tests prove that the models remove conditional heteroskedasticity up to 12 lags.

We conduct six GARCH-S(1,1) models with the purpose of estimating the volatility of the macroeconomic variables on stock returns volatility in Bangladesh using monthly data of the variables from January 2001 to December 2012. The extended version of GARCH-M model named, GARCH-S model has the ability to examine the impact of individual macroeconomic variable on the stock market returns volatility. Six GARCH-S (1,1) models suggest the following results.

- i. The ADF and PP test results show that the monthly return series of all variables are stationary. Positive excess kurtosis of 5.85 of DSI monthly return series indicates that distribution is leptokurtic. The p-value associated with Jarque-Bera statistics show that the monthly distribution of stock market returns is not normally distributed. Then an appropriate mean equation is formulated without any ARMA term. The insignificant correlation among the error term of the ARMA(0,0) model based on Ljung -Box Q statistics and Breusch-Godfrey Serial Correlation LM Test validates that the mean equation is efficient enough to capture the dynamics of the time series. The ARCH-LM test shows that the estimated residuals exhibit autoregressive heteroskedasticity (ARCH effect). Thus, we then proceed an extended version of GARCH-X model named GARCH-S model.
- ii. The results of six GARCH-S models indicate that including one exogenous macroeconomic variable such as  $\Delta$ API or  $\Delta$ OP or  $\Delta$ SENSEX in the variance equation produces significant ARCH and GARCH parameters, while including  $\Delta$ ER produces only significant GARCH parameter. Although, the sum of  $\alpha$  and  $\beta$  is less than one in all of the models, the time-varying volatility of the DSE returns is highly persistent including  $\Delta$ API or  $\Delta$ OP in the variance equation.
- iii. Regarding the impact of economic news, the  $\lambda$  associated with  $\Delta$ API or  $\Delta$ CMR or  $\Delta$ OP does not explain the volatility of the Bangladesh stock market. Hence,

the growth of industrial production index ( $\Delta IPI$ ), changes in the interest rate ( $\Delta CMR$ ) and crude oil price ( $\Delta OP$ ) have no significant impact on the volatility of the stock market returns.

- iv. There is a significant positive relationship between changes in exchange rate ( $\Delta ER$ ) and the volatility of DSE returns. This result indicates that the volatility of the Bangladesh stock market returns is expected to increase by 21% with an increase in the exchange rate of 1%.
- v. Results also reveal that there is a significant negative relationship between the growth of the broad money supply ( $\Delta M2$ ) and the volatility of Dhaka stock exchange returns. This implies that the volatility of the Bangladesh stock market returns is expected to decrease by 20% with an increase in the broad money supply of 1%.
- vi. Finally, we find that there is significant negative relationship between the volatility of Indian stock market ( $\Delta SENSEX$ ) and the volatility of Dhaka stock exchange returns indicating that the volatility of the Bangladesh stock market returns is expected to dampen down by 3% by an increase in the volatility of Indian stock market of 1%. Thus, the volatility spillover effect appears between Indian and Bangladesh stock market.

### **9.3 Outline for Future Research**

We use the all share price index (DSI) of Dhaka Stock Exchange, future studies may try to estimate the efficiency and volatility with the other indexes of DSE and also may use indexes of Chittagong Stock Exchange. Future researchers can investigate the behavior of stock markets applying alternative methodologies. They can investigate the effect of macroeconomic variables on stock prices using data of different frequencies of longer time periods. The inclusion of other macroeconomic variables can also be considered. Further studies on the Bangladesh stock market may wish to study the performance of individual stocks on the market and how each of these is



influenced by these macroeconomic fundamentals. Apart from macroeconomic issues, future researcher can use other factors like, company performance, market rumors, political instability, as well as international economic conditions that are known to influence to stock prices, efficiency of stock markets and volatility of stock returns.

#### **9.4 Conclusion and Policy Implications**

It goes without saying that a decent, efficient, transparent and less volatile capital market is essential for an emerging economy like Bangladesh for its rapid industrialization and economic development. None would like to see stock market of Bangladesh as a gambling place. Stakeholders hope that it will be a market for rational investors who have the mentality to tolerate the win-loss game by taking part in a knowledge-based investment. This study may help the investment analysts and the individual investors so that they can easily make an educated guess of the future investment by observing the past stock prices and macroeconomic variables. The results of this study gives some new references to the policymakers about the critical issues of the stock market in Bangladesh. It is fundamental responsibility of the BSEC and government to look after the stock market. Thus, government has to adopt the fiscal and monetary policy in such a manner that the stock market may not be affected suddenly. A major contribution have been added to the existing literature as we have explored two contemporary issues of stock market i.e., efficiency and volatility employing univariate and multivariate models.

This research successfully achieves its objectives and answered its questions. Some implications of these findings are:

- (i) Dhaka stock exchange is not efficient in semi-strong form and not even in weak form. Thus, all public information are not inherent in current share prices in the stock market of Bangladesh, meaning that fundamental analysis based on macroeconomic variables, and technical analysis based on historical stock prices can be used to achieve excess gains. These results

support the usual belief that the equity markets in the emerging economies are not efficient.

- (ii) Money supply defined by broad money supply is the largest positive determinant, while GDP proxied by industrial production index is the largest negative determinant of stock prices in Bangladesh in the long run.
- (iii) Investors in the Bangladesh stock market should look at the systematic risks revealed by the industrial production index or GDP, the price of crude oil, broad money supply, exchange rates and the Indian stock market in the long run when they structure portfolios and diversification strategies. They should also focus on the industrial production index or GDP, stock prices of India and interest rate or call money rate in the short run when they make a decision to invest in stock market.
- (iv) Policymakers of Bangladesh should acknowledge stock prices when formulating monetary and fiscal policies as stock price index of DSE is a leading indicator with respect to industrial production index and exchange rate in the short run.
- (v) Stock market returns of Bangladesh exhibit the well-known stylized facts, i.e., leptokurtosis, volatility clustering and leverage effect or asymmetric volatility. Weak regulations and surveillances of Bangladesh Securities and Exchange Commission (BSEC) should be improved as volatility rises when stock prices go down, and decreases when stock prices go up in stock market of Bangladesh.
- (vi) It is found that predicting the Bangladesh stock market returns volatility greatly depends on the changes which appear in the domestic and international macroeconomic factors specifically, exchange rates, broad money supply and the Indian stock market index. Bangladesh Securities and

Exchange Commission and authorities of Dhaka stock exchange may need to take these macroeconomic variables into account to develop fair, transparent, less volatile and efficient securities markets.

- (vii) Financial regulators and policymakers of Bangladesh may need to take economic variables, such as, stock prices of DSE, industrial production index or GDP, broad money supply, call money rate or interest rate, crude oil price, exchange rate and stock prices of Indian stock exchange into account when they formulate policies.

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