Indian Journal of Economics & Business, Vol. 10, No. 4, (2011) : 443-465

AN EMPIRICAL INVESTIGATION OF THE ARBITRAGE PRICING THEORY IN A FRONTIER STOCK MARKET: EVIDENCE FROM BANGLADESH

MUHAMMAD UMAR FARUQUE*

Abstract

Although the existing literature of Arbitrage Pricing Theory (APT) on different categories of stock markets is vast, it is non-existent in the case of frontier stock markets (defined as very small capital markets). This paper fills this gap by investigating how APT performs in a frontier stock market. To address the common problem of multi-collinearity in macro variables, this study uses principal component analysis (PCA) as a robustness check on the previous results. The results confirm evidence of one significant macroeconomic factor in the Dhaka stock market - a frontier stock market of Bangladesh. This result is comparable to that of some emerging (larger than frontier markets) stock markets.

Keywords: *Arbitrage pricing theory (APT), Capital-asset pricing model, Dhaka stock exchange (DSE), Principal component analysis, Principal components (PC), Efficiency market hypothesis (EMH) and Chen, Roll and Ross (CRR).*

JEL : *G10, G12,G11, G24, G32*

I. INTRODUCTION

Markowitz's (1952) theory of Portfolio Diversification has been instrumental in paving the way for modern asset pricing models to measure risks associated with equity returns. Subsequently, Capital Asset Pricing Model (CAPM) has been developed by Sharpe (1964), Linter (1965) and Mossin (1966). The Arbitrage Pricing Theory (APT) proposed by Ross (1976, 1977), has come as an alternative to CAPM measure of risk-return. The progress of models especially the APT appears to be influenced by the macroeconomic factors that intuitively affect capital investment. Whether the APT stands empirical viability has been tested widely time and again

* Department of Economics, Royal Holloway University of London, Egham, Surrey, UK, *E-mail: Umar.Faruque.2008@live.rhul.ac.uk*

Special thanks owed to Dr Vinay Nundlull, Dr Stacy Chan, Dr Hui-fai Shing, Dr Maris Goldmanis, Dr Molla, Dr Mahiuddin and Mr Tanvir for providing counsel and criticism.

hence there exists a dense literature e.g. Shanken (1982), Brown and Weinstein (1983), Chen (1983), Cho, Elton and Gruber (1984), Chen, Roll, and Ross (1986), Connor and Korajczk (1986), Burmeister and McElroy (1988), Lehman and Modest (1988), to mention but a few.

However, the literature is rather limited in that these theories especially the APT have been tested in large developed stock markets now and then. Though it is noted that the APT has already been tested in a few emerging markets e.g. in Pakistan, Turkey and Indonesia (among others) yet in the context of frontier stock markets, defined as less advanced and very small capital markets, the evidence is nonexistent.[1] The empirical test of APT in the Dhaka stock market would enable it to compare its performance in a Bangladeshi stock market with that of other stock markets around the world. Subsequently, it will have implications in investment decision-making for the capital markets of Bangladesh.

Thus, this study aims to fill the gap by investigating the APT in a rather small but rapidly developing stock market and in addition, contribute further evidence to the already existing literature of the empirical tests of APT. Dhaka Stock Exchange (DSE) is a premier stock market of Bangladesh which was incorporated in 1954. As of 2009 the total market capitalization (MC) of DSE amounts to USD19020.18 millions which approximately has a ratio of 1: 0.21 as GDP to Market Capitalization. Similar ratios for other countries are shown in the table below:

Table 1[2]
A Comparison of Market Capitalization Across a Range of Different Stock Markets

Country	*MC as a Percentage of GDP (in %)*
Bangladesh	21
Hong Kong	525.36
India	77.53
Malaysia	104.96
Indonesia	19.61
Pakistan	49
USA	102.01

Table 1 exhibits the small MC of DSE when compared to other stock markets in the region as well as in the world. The annual growth rate of MC in DSE was 135.28% in 2007 but somewhat subdued since then as a result of Global Financial Crisis. Consequently, in 2009 the growth rate of MC was 23.9%. In order to test the APT empirically, this study employs pre-specified macroeconomic factor approach developed by Chen *et al.* (1986) (CRR) that requires the use of two-pass regression methodology originally developed by Fama and Macbeth (1973). The dataset used in this study is a time-series data consists of 23 stocks and seven macro-variables for the period 1996-2010. It is noteworthy that CRR results suffer from robustness

check as time-series of macro-variables contains the possibility of multi-collinearity. To resolve this problem, this study incorporates principal component analysis into the regression model. The results confirm evidence of one significant macroeconomic factor in the Dhaka stock market. Furthermore, this study provides a critic of asset pricing models as they fall short of incorporating non-quantifiable factors that affect stock returns. To this effect, this study addresses the issue 'what constitutes stock returns' and uses the analysis to explicate the findings. The hypotheses of the present study are as follows:

H_0 1: macroeconomic factors do not influence stock returns in a frontier stock market.

H_0 2: stock returns are not affected by non-quantifiable factors such as 'market psychology'.

This paper is structured as follows: section 2 provides a literature review of APT; section 3 discusses some of the criticisms of asset pricing models; section 4 elaborates the methodology; section 5 analyses the data; section 6 discusses the findings of this study while section 7 summarizes and concludes.

II. LITERATURE REVIEW

1. Arbitrage Pricing Theory

The first empirical study of APT was done by Brennan (1971) in which he concluded that two risk-factors must represent return as opposed to single factor of CAPM. However, the first published work on APT was made by Gehr (1975) in which he carried out similar version of factor analysis approach. There were no further studies until Ross and Roll (1980) carried out their own empirical investigation of APT. The APT is based on the assumptions and insights developed in ICAPM[3] and Efficient Market Hypothesis (EMH)[4] and like CAPM it is a linear model though of multiple betas rather than single beta as in CAPM (Chen et al. 1986). Ross' (1976) criticism of earlier studies is that they are mainly tests of hypothesis that stock-index is mean-variance efficient, hence empirical tests of asset pricing models would hold only if true market portfolio (which is unattainable) can be calculated. However, some studies such as that of Shanken (1987) and Kandel and Stambaugh (1987) show less rigorous measures under which CAPM can be tested. Unlike Mean-variance portfolio where firm-specific risks can be diversified away the APT states that there are systematic risks in the economy that subject all the available stocks to same degree. The APT suggests that prices of risky assets abide by the law of no arbitrage. The APT predicts that stock/equity returns are influenced by a set of state variables e.g. GDP or Inflation or Interest Rate etc. The risk premium of each asset is sensitive to the risk premium of risk-factors (see e.g. Bodie *et al.* 2009). The empirical test of APT is carried out by two different approaches (factor analytic approach and pre-specified macro-factor approach) as formulated by Roll and Ross (1980) and Chen *et al.* (1986)(CRR) respectively, which are discussed in the Methodology part. In CRR's APT framework there is no binding on the selection of

number of risk factors. In contrast to this, French and Fama (1993, 96) formulate a 3-factor model that captures three specific factors influencing expected return. In the same mode of argument there has been 4-factor model or 5-factor model until Zhongzhi *et al.* (2010) propose a new model called DFPM (Dynamic Factor Pricing Model) which employs both ex-ante and ex-post factors and integrates elements of price dynamics across assets as well through time.

2. A Brief Sketch of the Empirical Results of APT

The empirical tests of APT have been carried out widely throughout the world from the USA to Greece to Indonesia (see e.g. Fabrian and Herwany (2010) and Michailidis (2009)). Several studies compare APT with CAPM or CAPM with French and Fama 3-Factor model (see e.g. Drew *et al.* (2003)). Most studies have focused on developed stock markets (see e.g. Asprem, 1989) while some of them compared developed stock markets with the emerging markets. Many studies have found evidence for APT while a few found against it (see e.g. Subramanyam, 2010).

Ross and Roll (1980) investigate APT using 42 groups of 30 individual securities for the period 1962-72 and find at least three significant factors, thus lays the empirical foundation of APT. The seminal work of CRR (1986) finds four priced factors for the period of 1958-84. However, their result suffers from lack of robustness which is investigated in detail by Shanken and Weinstein (2006). Shanken and Weinstein (2006) use post-ranking-returns approach as opposed to CRR backward-looking returns to address 'lack of robustness' in CRR results using the same data and they find that only industrial production index is significant among all factors. Their results show that CRR macro-variables are sensitive to alternative approaches. Shanken (1982, 85, 92) too makes a number of criticisms of the empirical viability of APT as for example, he argues that APT is more vulnerable than CAPM because it rules out the very expected return differentials which it tries to elucidate. However, his critique is not on APT itself rather it is directed on some methodological and empirical aspects of APT. In a critique of APT Dhrymes, *et al.* (1984) find that as one increases the number of securities, the number of 'factors' determined increases. This increase in the number of 'factors' with outsized groups of equities cannot readily be explained by a distinction between 'priced' and 'non-priced' risk factors as it is impermissible to carry out tests on whether a given 'risk factor is priced' using factor analytic procedures. However, Ross (1984) refutes the arguments posed against APT by Dhrymes, *et al.* (1984).

3. Some Empirical Results of APT in the Context of Emerging Stock Markets

The closest counterparts to frontier stock markets are emerging stock markets. Hence findings of APT as regards the emerging markets are relevant to this study. Dhankar and Esq (2005) analyze APT in the Indian stock market using monthly and weekly returns for the 1991-02 period, and show that APT with multiple factors provides a better indication of asset risk and return than CAPM which uses beta as

the single measure of risk. Using the pre-specified macroeconomic factor approach Azeez and Yonezawa (2006) test APT in a Japanese stock market and find that four different types of risk factors have significant influence on expected returns in each of the sample period. They are money supply, inflation, exchange rate, and industrial production. Ikbal and Aziz (2005) use both explanatory factor analysis and pre-specified macroeconomic approach with sixteen variables to test APT for Karachi Stock Market and find two priced factors in both cases. However, their result contains some evidence of instability as the value of R^2 is low. Fabrian and Herwany (2010) investigate the ability of both CAPM and APT to explain excess portfolio returns in the Jakarta stock exchange and find that while beta does not on its own explain excess returns, two macroeconomic variables namely exchange rate and interest rate spread appear to be significant in APT test. Altay (2003) performs APT for both the German and the Turkish stock markets and finds that while the evidence of APT exists for Germany it falls short in Turkey's case. Michailidis (2009) test both APT and CAPM in the Athens stock market for the period of 1997-04 and find that the CAPM performs better than the APT. Using the autoregressive model developed by Mei (1993) Ferreira and Rocha (2002) test APT in the Portuguese stock market and find two significant factors explaining stock returns. All these results show relevance of APT in emerging stock markets. Subramanyam (2010) reviews the literature on cross-section of expected stock returns for the past twenty-five years and draws the following conclusions. Too many predictive variables are used without a proper analysis of their correlation structure and studies generally fall short of accounting for the control in relation to a complete set of variables. A range of methodologies are applied but the robustness of the results is not adequately addressed across different methods.

The research at this stage shows the following characteristics:

- There exists a wealth of literature of APT covering a period of thirty years but no investigation has been done (to the best of our knowledge) in the context of frontier stock markets.
- Existing literature does not fully incorporate all the possible risk-factors that affect stock returns. The theories of Efficient Market Hypothesis and rational expectation on which APT bases its assumptions are not fully agreed upon by researchers (this issue is fully addressed in the ensuing section).

III. A CRITICISM ON SOME FEATURES OF ASSET PRICING MODELS

In the perspective of efficient-market theory and rational expectations of inter-temporal asset-pricing theory (see e.g. Cox *et al.* 1985); Chen *et al.* (1986) in their seminal study state that asset prices should be influenced by the macroeconomic factors that represent the economy. The theoretical basis of APT is drawn from this perspective. However, the argument and evidence from behavioral finance challenge this foundation. The works of RJ Shiller (see e.g. Shiller 1981, 84, 93, and 2005) call for attention, since for the last thirty years he has produced several studies in this regard suggesting alternative/additional factors that may affect stock prices.

It may be asked, why this debate persists for such a long time about the fundamentals of asset pricing models? One of the explanations states that since Enlightenment there is an unofficial concept of 'scientific attitude' in the academic circles that seeks for 'quantitative' and 'definitive' answers to intricate problems that are essentially 'ambiguous' or 'qualitative' in nature (see e.g. Shiller, 2005: p-18).[5] In his book, Shiller (2005) provides evidence and explanations about factors that influence the market and yet are not justified by the rationale of 'economic fundamentals'. He lists twelve such precipitating factors in the US context but many of these factors e.g. the idea that investing in stock means a way to become rich quickly; media-expansion of business report; increasingly optimistic forecasts by analysts, are also relevant to stock markets around the world. These factors are said to be amplified by investors' expectations and overconfidence which create a false impression of stock returns. Apart from this, cultural and psychological factors such as excessive Media report of financial news or peer pressure of equity investment etc. also carry weight in explaining fluctuations in stock prices.

1. The Perspective of Behavioral Finance

Shiller's argument has resonance in the field of behavioral finance which argues that irrationality on the part of agents in financial market can be explained using models that account for agents' irrationality (Barberis and Thaler, 2003a). Selden (1912) provides a framework on the belief that movement of stock prices depends to a large degree on the psychology of financial investors. The domain of human behavior cannot be quantified like other observable variables, hence researchers who discuss psychological factors in relation to stock returns rely themselves on intuitive argument and related indicatory data. Counter to the principles of Efficiency Market Hypothesis (EMH) hypothesis, behavioral finance seeks to expound 'why' and 'how' markets might be inefficient reflecting unpredictable nature of the collective 'human psyche' (Sewell, 2007). Akerlof and Shiller (2009) provide several arguments that 'human psychology' does matter in economic models and theories, but since they could not specify a 'new' model that replaces old models their argument suffers negative criticisms (Farmer, 2009). However, the core of the problem remains unchanged even if one fails to devise a new paradigm.

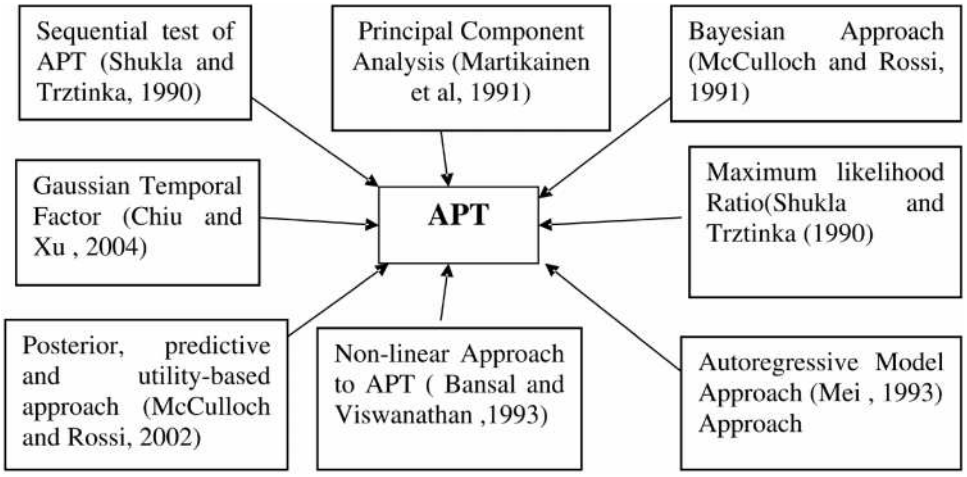
The arguments from the preceding paragraphs delineate that there is no 'exact' answer to the question why 'stock prices' are volatile or takes a 'random walk,' so empirical investigations are more viable when considered in a broader context. Thus, the present investigation considers both qualitative and quantitative factors that affect stock returns.

IV. METHODOLOGY

I. The Range of Approaches to the Empirical Tests of APT

The empirical test of APT can be approached from various angles which are exhibited in the diagram below:

Figure 1: Range of Approaches to the Empirical Tests of APT



2. The Framework of the Present Methodology

The previous section demonstrates the different statistical methods that can be incorporated while carrying out empirical tests of APT to enhance its estimates. The methodology of APT as developed by Chen *et al.* (1986) thus allows flexibility in its framework. However, there are two main methods by which most of these studies investigate APT (while integrating a specific statistical tool into the framework e.g. principal component analysis for this study): explanatory factor analysis and pre-specified macroeconomic approach. This study uses *pre-specified macroeconomic factors approach (PMF)* developed by Chen *et al.* (1986). Regressions are also run using principal components analysis (PCA) to remove multi-collinearity in macro-variables and enhance statistical accuracy of the results. The characteristic feature of principal components is their uncorrelatedness, hence coefficient of principal components (PC) remained unaltered even though another PC is incorporated into the equation whereas in the case of original variables any addition/ removal of variable changes the contribution and coefficient of regression model. This holds true when multicollinearity is present in the model (Flury and Riedwyl, 1988, p. 212).

One of the main advantages using the macroeconomic variables approach is that it names the factors. Since pre-specified macroeconomic factors approach names factors, it provides a more direct link between various corporate strategic policies (e.g. capital structure and dividend policy) and changing economic events. However, unanticipated changes in the macro-variables are difficult to measure that are required to proxy for the factors. As a consequence, some variables like oil prices, which have semi predictable movements, are unlikely to show up as factors even though they might be genuine factors (Grinblatt and Titman, 2002: p-186). Although PMF approach specifies factors beforehand it falls short of quantifying pertinent

factors e.g. political changes, like the fall of Berlin Walls may have a big effect on stock returns but it is difficult to construct an index of crucial political episodes (Claude *et al.* 1996).

Even though this study primarily leans on Chen et al. (1986) paper it faces some limitations while implementing some aspects of CRR methodological framework. The primary feature of the PMF approach is its lack of formal theoretical guidance for choosing the variables. There is 'no fixed number of variables' that one has to incorporate in the PMF framework. As a result, procedures for selecting an appropriate set are informal at best. The lack of a defined framework is prominent given the highly correlated nature of many economic time series variables. Macroeconomic data are also vulnerable to measurement problems especially over short horizons (Chen and Jordan, 1993). However, as the study by Chen and Jordan (1993) demonstrate there is insignificant difference in terms of results when both exploratory factor and pre-specified macroeconomic factors approaches are compared but PMF seems to perform better.

After personal meetings with the officials of Bangladesh Bank Statistic Dept. it is found that there is no recorded data for 'expected rate of inflation' before 2008. Besides, inflation is a controversial issue in Bangladeshi politics and its data is reported to be manipulated.[6] Considering all these limitations, this study cannot formulate 'unanticipated' change in inflation. Instead, it uses a proxy variable-CPI National Index to reflect changes in inflation. The variable 'term structure' faces similar problems. In Bangladesh, the use of Bond and T-bill is still infrequent. During 1996-2005 periods t-bill rate and bond rate have remained unchanged month after month which is why it is not included in the regression. Taking all these factors into account this study chooses seven macroeconomic factors (in contrast to five such factors in CRR): (1) Change in Industrial Production Index (2) Changes in Exchange Rate (3) Change in CPI National Index (4) Change in Export (5) Change is Interest Rate (6) Change in Money supply (7) Change in Import. All these factors are found to be priced in various studies in varying contexts. To test the APT using pre-specified macro-economic factors, following two-pass regression methodology is used for the period 1996-2010. Time series data are collected for 23 stocks and then monthly time series of stock return data for 180 months is computed using the formula: $StRn_{it} = F_{t+1}\text{-}F_t/F_t$, where i is the individual stock in month t and F is the return value of the stock i in the corresponding month. There are total 179 observations instead of 180 as the macro variables are measured in rates of change instead of absolute values. The rate of change is calculated using logarithmic differencing which renders the series stationary. Time-series regressions of asset returns on macro-variables is first estimated for each stock i to obtain asset sensitivities, known as 'factor betas,' denoted by $\beta_i = (\beta_{i1}, \beta_{i2 \ldots} \beta_{ik})$, where k is the number of factor betas.

$$R_{it} = \alpha_i + \beta_{i1} F_1 + \beta_{i2} F_2 + ... + \beta_{ik} F_k + e_{it} \qquad (1.1)$$

where R_{it} is the return of the stock i at month t, α_i is the stock specific effect for stock i, F_j's (j = 1, 2,....k) are macroeconomic factors (or factor scores), all of which

are specified in the *Appendix 1* and e_{it} are the unsystematic return components of the stocks. Using these factor sensitivities as independent variable and stock average returns as dependent variable, the following second 2nd pass cross-sectional regression is run to test which factors are priced:

$$R_i = \delta_0 + \delta_{i1}\,\beta_1 + \delta_{i2}\,\beta_2 + \ldots + \delta_{ik}\,\beta_k \qquad (1.2)$$

where $\bar{R}i$ is the average monthly return for security and δ_0 is the constant and $\delta_i = (\delta_{i1} \ldots \delta_{ik})$ are coefficients of sensitivities of asset returns to changes in macroeconomic factors. The coefficients of factor sensitivities in the 2nd pass regression measure the size and significance of the estimated risk premium related with each macro factor. The whole process is repeated to obtain regression results for two sub-periods: (i) December 1995 to November 2001 (ii) December 2001 to November 2010. The reason for this division is to account for the implausible movements in DSE index that occurred during 1996-98 periods as well as periodic fluctuations of DSE index that originate from speculation of political events and unidentified reasons. Moreover, regressions on sub-periods help to analyse stability factor. A sub-period needs to contain 60 months as a prerequisite to effect substantial interpretation of results according to CRR methodology.

V. DATA

The Data consists of 23 most actively traded stocks from DSE covering the period from December 1995 to November 2010. Stock returns data are collected in Compact Disk format from the office of Dhaka Stock Exchange and put into time series form.[8] Macroeconomic variable data are collected from International Financial Statistics (IMF) database and 'Monthly Economic Trends' of Bangladesh Bank. The IFS database contains time series data for over two hundred countries in the world on a wide range of economic topics. However, the IFS database does not contain recent figures (2010 onward) for macro-variables that are used in this study. Moreover, it has a few missing observations it its time series data. The missing observations and recent estimates of macroeconomic variables are collected from 'Monthly Economic Trends' of Bangladesh Bank- a monthly journal available on its website.[9] The dataset used in this study has limitation being a 'developing country data' which is less reliable from that of developed countries. This is so because in developing countries data is not recorded and preserved well. The key institution responsible for recording data in Bangladesh is Bangladesh Bureau of Statistics, and it is found that it does not have recorded macro variables data prior to 2000. The statistic department of Bangladesh Bank publishes Monthly Economic Trends but it does not preserve macro-variables in time series format. Moreover, after personal investigation, the researcher finds that neither Bangladesh Bank nor Bangladesh Bureau of Statistics have developed statistically reliable data recording process. One instance of this is found in various copies of 'Monthly Economic Trends' in which figures for the same indicator is found to be different in various issues.[10] The stock returns data are recorded on a daily basis, and are found to be in acceptable

condition, and these same data are used in a number of studies mentioned in the preceding section. The stock return dataset contains seventeen missing observations. To proxy for all these observations similar industry return data is used. Furthermore, in developing countries macroeconomic data is reported to be manipulated in favor of the government.[11] The data shows that average returns for all the stocks are positive. Three stocks are found to be negatively skewed and some stocks demonstrate very high Kurtosis e.g. 114.088. The standard deviation of the overall stock return data is medium.

1. Dhaka Stock Exchange: Some Findings

During a transition of government in 1996 the DSE index has risen sharply without any reference to the market fundamentals. On 31 May 1996 the DSE index was 804 which then rose to 3596 by 17 Nov 1996 and then plunged to 622.28 on 16 April 1998. The instances of such fluctuation are a common characteristic of DSE. As recent as in Dec 2010 the DSE index rose to all-time high and then plummeted and then mounted again followed by a steep fall. All these events have taken place in a week's time.[12] Basher *et al.* (2007) find that Time-varying volatility and equity returns for the DSE returns show negative skewness, excess kurtosis and deviation from normality. Furthermore, in Bangladesh the processing of new information is weak because of the presence of a large number of non-actively traded shares and inadequate institutional background for broker houses and mutual funds. In conjunction with all these facts and results Mollik and Bepari (2009) find Dhaka Stock Market to be 'weak-form inefficient' while a study (Mollik and Bepari , 2010) by the same authors investigates beta-instability in DSE over a period of 2000-07 and show that beta is highly unstable and this instability increases with holding periods.

VI. RESEARCH FINDINGS ANALYSIS

1. Derivation of Principal Components

Table 2
Rotated Factor (Components) Pattern of the Macroeconomic Variables 1996-2001

Variable	*Component 1*	*Component 2*	*Component 3*	*Communality*
Exchange rate	-0.2517	-0.0649	0.6593	0.4249
CPI Index	-0.3578	0.014	0.2816	0.7252
Industrial Prod. Index	0.5393	0.1414	0.1739	0.5361
Bank rate	0.288	0.0381	0.6438	0.4669
Export	-0.1662	0.6882	-0.1457	0.3005
Money Supply	0.6238	-0.1249	-0.0835	0.4298
Import	0.1346	0.6964	0.1143	0.2802
Eigenvalue	1.45768	1.33612	1.04251	3.8362
Rate of Determination	0.1998	0.1977	0.1505	0.548

Table 3
Rotated Factor (Components) Pattern of the Macroeconomic Variables 2002- Nov 2010

Variable	*Component 1*	*Component2*	*Component3*	*Communality*
Exchange rate	0.0609	0.4518	-0.2831	0.6051
CPI Index	0.208	-0.3011	0.4149	0.6054
Industrial Prod. Index	-0.066	0.7177	0.1438	0.2843
Bank rate	-0.033	0.1136	0.7841	0 .298
Export	0.4891	0.3773	0.198	0.2892
Money Supply	0.6458	-0.183	0.0231	0.2991
Import	0.5398	0.0369	-0.2694	0.4501
Eigenvalue	1.74472	1.32485	1.09918	4.1688
Rate of Determination	0.2369	0.1972	0.1615	0.5955

Tables 2 and 3 present factor loadings for seven macro variables which are obtained by principal component analysis[13] and Kaiser's orthogonal varimax rotation for the sub periods 1996-2001 and 2002-Nov2010. After rotation of all variables three components are retained according to Kaiser's variance criterion which suggests to retain those factors with Eigenvalues (total variance accounted for each factor) equal or higher than one. The rotation is varimax which produces orthogonal factors. This implies that problems of multi-collinearity are removed and dimensionality of the original variables is reduced. The pattern matrix in Table 2 and 3 offers a concise picture of the relevance of each variable in the principal components. Component (factor) 1 Table 2 indicates industrial production index and money supply since these have the highest factor loadings (correlation with the factor scores) in it while Component 2 represents import and export for similar reasons. Component 3 refers to exchange rate, bank rate and inflation. The coefficients of all respective components show positive sign. Communality is the variance that is 'unique' to the variable and not shared by other variables e.g. 42.49% of variance in variable exchange rate is not shared by any other factor. The total variance explained by all factors in Table 2 is 54.80%. Analogously in Table 3, export, money supply and import correspond to component 1 and exchange rate and industrial production represent component 2. The last component represents remaining factors by its corresponding high loadings and total variance accounted for all components is 59.55%. Similar process is employed to extract PCs for the period 1996-2010.

2. First Pass Regression and Robustness of the Results

First pass regression is carried out according to the equation below:

$$R_{it} = \alpha_i + \beta_{i1} F_1 + \beta_{i2} F_2 + ... + \beta_{ik} F_k + e_{it}$$

An aggregate of 138 time series regressions are carried out employing PCs as wells as without PCs as explanatory variables. This is done to add robustness to

the findings. One period has 23 regressions and a complete set (e.g. using PCA) has three different periods and two such sets add up to 138 equations. The R^2 range and F-value range exhibit medium strength compared to other studies (e.g. Gunsel and Cukur, 2007). The highest R^2 value found in regression using seven macro-variables is 30% while that of the lowest value is 0.31%. The range of the F-value shows similar fluctuation from 3.98 to 0.08. Most of the values in both F-test and R^2 range however, lie in the middle of the highest and the lowest value. The large fluctuation implies some stocks are inactive while others are hyper-active and equities' varying degree of responsiveness to macro factors. Similarly, the F-value and R^2 range show large variation when regression is done using PCs in all the three periods. The highest value for F-statistics and R^2 are 9.38 and 29.27% while lowest values are 0.11% and 0.07 respectively. To check serial correlation of stock returns data Breusch-Godfrey LM test is carried out after each of 138 regressions. Table 4 and 5 demonstrate whether autocorrelation is present in the results.

Table 4
Autocorrelation Test of Regression Output (First Pass) Using Macro-variables (1996-2010)

	Reg 1	*Reg 2*	*Reg 3*	*Reg 4*	*Reg 5*	*Reg 6*	*Reg 7*	
Breusch-Godfrey LM (12)***	16.994	1.734*	12.954	17.593	10.81	12.495	1.465*	
	Reg 8	*Reg 9*	*Reg 10*	*Reg 11*	*Reg 12*	*Reg 13*	*Reg 14*	*Reg 15*
Breusch-Godfrey LM (12)	12.656	11.792	8.309	6.82	7.08	22.491**	18.07	13.961
	Reg 16	*Reg 17*	*Reg 18*	*Reg 19*	*Reg 20*	*Reg 21*	*Reg 22*	*Reg 23*
Breusch-Godfrey LM (12)	0.875*	6.016	13.343	24.628**	30.222**	10.144	4.115	19.85

Notes: dependent variable: monthly stock returns; independent variables: changes in macro variables (7)

*Tested with 1 lags (1 degree of freedom); ** Serially correlated; ***12 lags (12 degrees of freedom).

Table 5
Autocorrelation Test of Regression Output (First Pass) Using PCs (1996-2001)

	Reg 1	*Reg 2*	*Reg 3*	*Reg 4*	*Reg 5*	*Reg 6*	*Reg 7*	
Breusch-Godfrey LM (1)***	2.763	1.761	0.047	0.028	15.913*	0.784	3.468	
	Reg 8	*Reg 9*	*Reg 10*	*Reg 11*	*Reg 12*	*Reg 13*	*Reg 14*	*Reg 15*
Breusch-Godfrey LM (1)	2.145	0.434	2.955	0.136	2.337	15.157*	2.687	0.271
	Reg 16	*Reg 17*	*Reg 18*	*Reg 19*	*Reg 20*	*Reg 21*	*Reg 22*	*Reg 23*
Breusch-Godfrey LM (1)	0.198	0.141	2.958	19.921*	7.352 **	0.735	1.032	1.4

Notes: dependent variable: monthly stock returns; independent variables: principal components (3)

*Tested with 12 lags (12 degree of freedom); ** Serially correlated; ***1 lags (1 degrees of freedom)

Table 4 and *5* show Autocorrelation results for two different periods. Some of the tests in both tables are done using 12 degrees of freedom since observations one year ago can influence present value. The results in other periods show no autocorrelation. Table 4 exhibits presence of autocorrelation in three cases where as Table 5, for that matter does in one instance. Thus evidence of autocorrelation is minimal. This result is comparable to that of Gunsel and Cukur (2007) and Febrian and Herwany (2010).

3. Analysis of 2nd Pass Regression

The 2nd Pass cross-sectional regression results are obtained using the equation below where,

$$R_i = \delta_0 + \delta_{i1}\,\beta_1 + \delta_{i2}\,\beta_2 + \ldots + \delta_{ik}\,\beta_k$$

dependent variable is the Average Monthly Return and independent variables are factor betas calculated in First Pass.

Table 6
Results of Cross Sectional Regression (2nd pass) Using Principal Components (3 periods)

Period	*Constant*	*δComp1*	*δComp2*	*δComp3*	R^2	*F-value*	*Breusch-Pagan Test-chi2(3)*[c]
1996-10	0.025645 (5.76)[b]	0.2839103 (1.45)	0.392069 (1.02)	-0.24393 (-0.86)	0.1388	1.02	14.49
1996-01	0.028952 (6.61)[b]	-0.10001 (-0.62)	-0.18939 (-2.03)[a]	0.42962 (1.45)	0.1871	1.46	16.40
2002-10	0.0260347 (5.14)[b]	-.1084147 (0.04)	.3357553 (1.03)	.0153012 (-0.44)	0.0551	0.37	5.28[b]

Notes: dependent variable: average monthly stock returns; independent variables: sensitivities of asset returns to Principal Components derived; (t-values in parentheses),[a]significant at 0.10 level, [b]significant at 0.05 level, [c]three degrees of freedom.

Table 6 shows results of 2nd Pass regression in which only one factor is found to be priced at 10% level of significance in all the different periods. However, high t-values of constant indicate association of additional state variables that are not included in the study. From the preceding section it is known that component2 represents export and import and they exhibit negative relation with the stock returns. The R^2 shows low value in sub-period 2002-10 and in other periods it is comparatively higher though not high enough to render the results stable. The F-values in all periods are insignificant since $F_{critical}$ at 5% level of significance lies above all of them. This result is similar to what is found for Finnish Stock market by Martikainen *et al.* (1991) in one of the sub periods. But since regression contains only 23 observations F-test becomes predictable. Breusch-Pagan test of heteroskedasticity shows only results obtained in sub-period 2002-10 are not heteroskedastic. In a similar pattern Table 7-9 are analysed below.

Table 7
Results of Cross Sectional Regression (2nd pass) Using Seven Macro-factors 1996-2010

Period	*δbeta1*	*δbeta2*	*δbeta3*	*δbeta4*	*δbeta5*	*δbeta6*	*δbeta7*	*Constant*
1996-10	.0110252	-.00190	.0160187	-.005319	.0143759	-.00630	.03964	.032225
	(2.22)[b]	(-0.70)	(0.78)	(-0.48)	(0.43)	(-0.39)	(0.74)	(4.19)[b]

R^2 : 0.3427

F-value : 1.12

Breusch-Pagan test: chi2 (7): 30.35

Notes: dependent variable: average monthly stock returns; independent variables: sensitivities (factor loadings) of asset returns to changes in macroeconomic variables; (t-values in parentheses),[a]significant at 0.10 level, [b]significant at 0.05 level.

Table 8
Results of Cross Sectional Regression (2nd pass) Using Seven Macro-factors 1996-2001

Period	*δbeta1*	*δbeta2*	*δbeta3*	*δbeta4*	*δbeta5*	*δbeta6*	*δbeta7*	*Constant*
1996-01	.005707	-.00212	-.00477	-.003426	.00813	-.00024	.047375	.024931
	(1.22)	(-1.07)	(-0.23)	(-0.64)	(0.47)	(-0.04)	(0.99)	(3.86)[b]

R^2 : 0.2720

F-value : 0.80

Breusch-Pagan test: chi2 (7): 16.11

Notes: (t-values in parentheses), [a]significant at 0.10 level, [b]significant at 0.05 level.

Table 9
Results of Cross Sectional Regression (2nd pass) Using Seven Macro-factors 2002-2010

Period	*δbeta1*	*δbeta2*	*δbeta3*	*δbeta4*	*δbeta5*	*δbeta6*	*δbeta7*	*Constant*
2002-10	.004538	-.00024	.013433	-.00298	-.031484	-.00603	.008709	.0284091
	(1.03)	(-0.09)	(0.85)	(-0.27)	(-0.57)	(-0.39)	(0.13)	(4.74)[b]

R^2 : 0.1805

F-value: 0.47

Breusch-Pagan test: chi2 (7): 16.42

Notes: (t-values in parentheses), [a]significant at 0.10 level, [b]significant at 0.05 level.

The result in Table 7 shows the existence of one significant factor at 0.05 levels while no other significant factor is found for other periods. The corresponding significant factor is exchange rate which is also found to be priced in an Indonesian stock market in a study by Febrian and Herwany (2010). The R^2 shows relatively higher values particularly in 1996-2010 periods when it is 34.27% compared to that of Table 6 but F-values are lower as compared with those of Table 6. The constants are significant in all cases and test of heteroskedasticity is not passed in any cases. To correct for heteroskedasticity different functional forms are attempted for dependent variable but these renders t-values insignificant after corrected forms of variable is regressed. The coefficient of beta-2 is inflation which shows negative

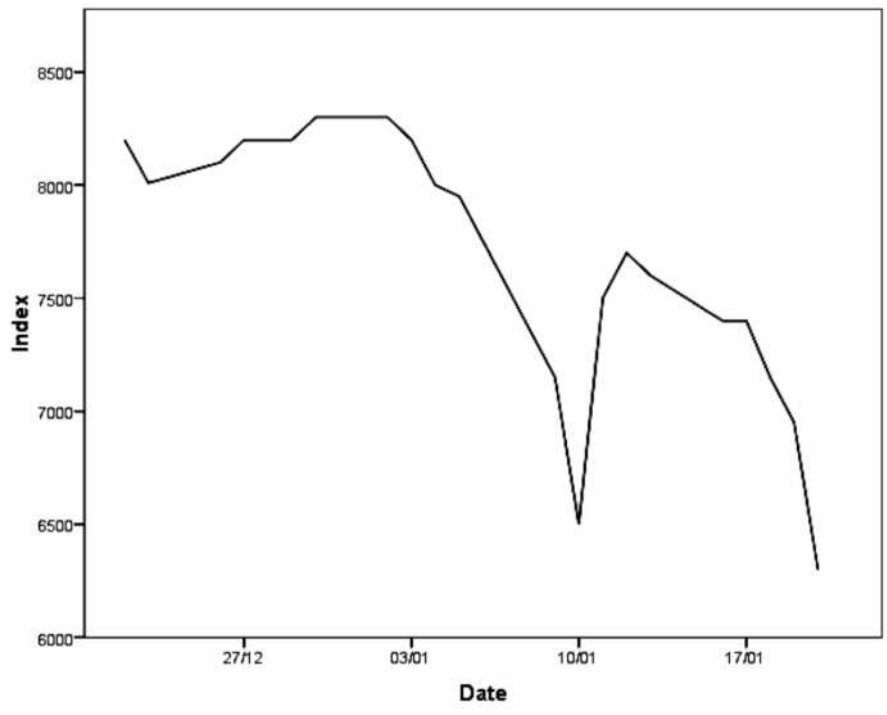
association with stock returns. This is consistent with the result found in Asprem (1989), Chen *et al.* (1986), and Kaul (1987) who all attempt to explain negative relationship between inflation and stock returns. Although there is no theoretical basis for the signs of state variables as noted by CRR yet their signs are indicative of the plausible relation between stock returns and macroeconomic factors. Table 7-9 shows signs of inflation (beta 2) and bank rate (beta 4) to be negative while that of industrial production to be positive (except for one period) which is consistent with CRR and Febrian and Herwany (2010) findings. The signs of export (except in one instance) and import are positive while that of money supply is negative similar to what is found in Türsoy *et al.* (2008) and Azeez and Yonezawa (2006). Although CRR finds five priced factors their results lack robustness which is fully addressed by Shanken and Weinstein (2006) in a seminal paper in which they use same data but find no significant factors in one of the sub-periods as opposed to five factors found in CRR for the same period. They only find one priced factor in the overall period of 1958-83, thus subjecting CRR results to further scrutiny. The F-values (1.27 is highest) found in Shanken and Weinstein (2006) for the period 1968-77 is similar to what is found in this study. The R^2 found in this study is lower than that of Indian, Indonesian and Pakistani stock markets as evidenced in Dhankar and ESQ (2005), Febrian and Herwany (2010) and Iqbal and Aziz (2005) respectively while it is similar to what is evidenced in Turkish Stock Market by Tursoy *et al.* (2008). The results in this study also show instability similar to that of Iqbal and Aziz (2005) as a consequence of low R^2-adj. All in all, the findings exhibit similarities to those of Turkish, Pakistani and Indonesian stock markets as discussed in this section. This is encouraging because with longer time horizon and larger sample size the robustness of the results is likely to be augmented.

4. A Wider Context of the Results

Overall, the results demonstrate the existence of one priced factor in DSE but after correcting for heteroskedasticity t-values become insignificant. The possible reasons are numerous. DSE is shown to be weak-form inefficient market (Mollik and Bepari, 2009). Moreover, evidence (explored in the following) suggests that artificial maneuvering by large investors frequently leads to unexpected fluctuation in stock prices with no relation to market fundamentals. Since DSE is a small market a syndicate of traders who own large volume of shares would be able to control 'share price.' There are 27 broker houses for a total number of 3.5 million investors (increased from 500,000 since 2007) and a population of 150 million.[14] According to Financial Express (Jan 2011a) thousands of accounts (called 'Beneficiary Owner' account needed to trade in the secondary market) were opened and broker-house branches were permitted to operate throughout the country without any intervention of regulatory bodies to investigate if false accounts were being issued. Despite the increase in number of investors, the numbers of broker-houses remain proportionately lower. The number of broker-houses in Bangladesh is proportionately lower than that of Karachi Stock Exchange in Pakistan which has over 600 broker-houses for a population of over 170 million.[15] However, Karachi

stock market is relatively larger than the DSE. On 20th Jan 2011 stock market has had to be suspended as DSE index fell by 600 points in five minutes time. However, such events have occurred in last one month since 20th Jan'11 as fig.2 shows below:

Figure 2[16]: DSE Index Movement -22Dec 2010 to 20 Jan 2011



As the stock market collapsed the Finance Minister of Bangladesh admitted its failure and said that government has failed to control the market and was unable to track down the "vicious syndicate" of traders (Financial Express, Jan 2011b). Following the incident, the stock-market regulators suspended six stockbrokers for one month on charges of manipulation in the secondary market (Daily Star, Jan 2011). An ex-governor of Bangladesh Bank says the recent failure in the stock market could not have happened if responsible perpetrators were punished in 1996 stock market bubble as referred to in previous sections (Financial Express, Jan 2011c). Various media reports bring out the following features of DSE: limited access to information, city centred trading, imperfect trading system and inadequate learning opportunities for market participants, limited choice for investors in terms of diversification, and poor regulation, all contribute to the current events of DSE which moreover, are characteristics of frontier stock markets in general.[17] However, even if all of these factors were not associated there would be no assurance that APT holds well in Bangladesh since movement in stock prices does not always depend on market fundamentals as argued in preceding sections.

5. Limitation of Findings

This study has limitations in different dimensions. The data horizon of this study is shorter by eleven years than that of CRR (1986) research. But data are not available in Bangladesh to extend the time-period of the study. The number of stocks selected for this study is small. With a larger sample size, the robustness of the results is expected to increase. Important factors like unanticipated inflation and term structure rates are not incorporated in the regression as in CRR since relevant data and context, as explained in the previous section, are not found. Finally, the research is conducted only on one frontier stock market. A comparison with other frontier stock markets would be insightful.

VII. CONCLUSION

This paper assesses the performance of APT in a frontier stock market in Bangladesh. To test the applicability of APT, this study employs CRR (1986) methodology and uses data for the period 1996-2010. To address the problem of multi-collinearity in macro-variables, this study uses principal component analysis. Only exchange rate is found to be priced out of seven macroeconomic variables. However, the results should be treated with caution as the significance of t-values has altered after correcting for heteroskedasticity. The focus of this research is a frontier stock market, and it is a first of its kind in this respect since previous studies are administered in the context of secondary emerging, advanced emerging and developed stock markets. Nevertheless, the evidence found in this study is comparable to that of Turkish and Pakistani stock markets taking into account the latter are 'secondary emerging stock markets.'

The principles of APT are derived from the hypothesis that there are systematic sources of risks in the economy that are represented by state-variables that affect all equity returns. This is consistent with the efficiency market hypothesis that states factors influencing stock prices should be justified by 'market fundamentals.' In contrast, the arguments of Shiller (2005) provide an alternative paradigm which state that stock prices are not exhausted by the unique influence of state-variables. The presence of non-quantifiable factors such as 'market psychology' also plays a part in explaining the stock returns. The domain of behavioral finance presents evidence to this regard which is discussed at length. Earlier studies (e.g. Mollik and Bepari, 2009) find that DSE is 'weak-form inefficient' and evidence in the 'Findings' section demonstrates the presence of non-quantifiable factors such as artificial manipulation of share-price etc. in DSE which are consistent with the proposition of behavioral finance. Thus, both null hypotheses are rejected in favor of the alternative. The implication of all these conclusions bears meanings for the investment community in that investment decision, in a frontier stock market is likely to be governed by uncertain factors. However, as 'antecedent discussion' of this study argues it is far from being settled 'what factors constitute stock returns' and the wide array of approaches employed by researchers make it difficult to confer a conclusion in this regard. There exists no 'holistic model' which accounts

for both quantifiable and non-quantifiable factors that affect stock returns. However, a detailed discussion of such model is beyond the scope of this study and should be extended for future research. The criticism that many studies of APT suffer from 'pricing error' (see e.g. Zhang and Wang, 2006), and robustness check, is addressed in the present study. To improve the results further, this study recommends using longer period of data with more frequent stock trading e.g. weekly returns data, as well as larger sample size and incorporating more macro variables. Since the focus of this study is a frontier stock market, a comparative study of APT on two or more frontier stock markets should constitute for future research to gain relevant insights.

Notes

1. Frontier stock markets are less advanced and very small capital markets from the developing world e.g. Bangladesh, Botswana, and Serbia etc. Definition adapted from Investopedia at (*http://www.investopedia.com/terms/f/frontier-market.asp*). FTSE Global Equity Index publishes 'ranking' of all different stock markets at *http://www.ftse.com/Indices/FTSE_Frontier_Indices/index.jsp*
2. MC calculated before 'Sub-prime crisis' occurred in 2007 because after the crisis the respective MCs of different stock markets were changed as some countries remained less affected by the crisis.
3. Inter-temporal capital asset pricing model developed from portfolio selection behaviour is an equilibrium model.
4. According to the EMH, stocks always trade at their fair value on stock exchanges, which makes it unattainable for investors to either purchase undervalued stocks or sell stocks for inflated prices. Although it is a foundation of modern financial theory, the EMH is very controversial.
5. Shiller draws the example of 'Fall of Rome' to demonstrate that exact quantifiable reasons cannot be constructed to explain such phenomenon.
6. One example of contradictory inflation figures is seen in the dataset obtained from IFS in which 'rate of inflation' significant differs from 'CPI index' during 2000-02 periods.
7. Figures calculated from Export Promotion Bureau Bangladesh at *http://www.epb.gov.bd/index.php?NoParameter&Theme=default&Script=publication*
8. data is collected in person and it is found in excel sheet with returns against specific dates.
9. In the IFS dataset 37 missing observations were found which were then collected from various issues of Monthly Economic Trends.
10. a few observations for 'money supply' were found to be different in different issues which were then adjusted by taking their 'average' values.
11. since there is no unbiased transparent institution for overseeing statistical record there is an opportunity for government to manipulate data in its favor.
12. source: index chart of DSE it its website at *www.dsebd.org*
13. principal components are obtained using relevant commands in the STATA. There are different methods to obtain principal components e.g. Martikainen et al. (1991) obtain PCs using 'principal component factoring' (pcf) whereas this study derives PCs using PCA which retains some correlatedness unlike principal component factoring which completely removes 'correlation.' However, regressions are conducted using pcf as well and the results do not show any significant alteration.

14. source: Bangladesh Trade Directory available at *http://www.bangladeshtrades.com/bangladesh-business/stock-market-bd/bangladesh-stock-brokers-house-4.html*
15. source: Pakistan Stock Exchange at *http://stockexchangepakistan.info/karachi-stock-exchange-list-of-members/*
16. source: Financial Times on 21st Jan 2011 available at *http://www.thefinancialexpress-bd.com/more.php?news_id=123566&img=1&date=2011-01-21*
17. source: various issues of the Financial Express, the Daily Star, Prothom Alo, and Amar-Desh collected online from *www.sonarbangladesh.com*

Appendix I
Variable Specification

Inflation Rate: A number of studies find Equity returns to be negatively associated with inflation (see e.g. Fama, 1981; Kaul, 1987). Change in Inflation is calculated as follows:

$R(INF_j)_t = Ln\ (INF_j)_t - Ln(INF_j)_{t-1}$

where $R(INF_j)_t$: change in inflation; $Ln\ (INF_j)_t - Ln(INF_j)_{t-1}$: Monthly logarithmic difference of inflation (series).

Industrial production Index: The profitability, spending, and employment level of a firm is affected by fluctuations in industrial production. The series is computed as follows:

$R(IPD_j)_t = Ln\ (IPD_j)_t - Ln(IPD_j)_{t-1}$

where $R(IPD_j)_t$: change in Industrial production index ; $Ln\ (IPD_j)_t - Ln(IPD_j)_{t-1}$: Monthly logarithmic difference of IPD(series).

Money Supply: In this study M0 (measure of broad money) is used which is consistent and widely used across several studies and the series is measured using the same procedure as in the case of inflation.

Export: Export sector is a blooming industry in Bangladesh. In 1980 the total value of export was 1000 USD millions where as in 2006 the figure rose to 12000USD millions. In real terms that is more than 250% increase.[7] A number of studies such as Beenstock and Chan (1988) use Export variable in their research. The series is obtained through calculating logarithmic difference in every month.

Bank Rate: Unlike developed economies where interest rate is fixed by the Central Bank every month Bangladesh Bank does not publish separate 'bank rate.' What is used as an interest rate variable is the average of borrowing and lending rate which is available from the journal of Bangladesh Bank.

Import: The series is obtained using the same procedure as in the case of variable Export.

References

Azeez, A. and Yonezawa Y., (2004), "Macroeconomic Factors and the Empirical Content of the Arbitrage Pricing Theory in the Japanese Stock Market", *Japan and the World Economy,* 18 (2006), 568–591.

Akerlof, A. G. and Shiller, J. R. (2009, pp. 130-35), *'Animal Spirits: How Human Psychology Drives the Economy, and Why it Matters for Global Capitalism*,' (Princeton University Press, Princeton and Oxford, 2009).

Asprm, M. (1989), Stock Prices, Asset Portfolios and Macroeconomic Variables in Ten European Countries, *Journal of Banking and Finance*, 13, 589-612.

Altay, E., (2003), "The Effect of Macroeconomic Factors on Asset Returns: A Comparative Analysis of the German and the Turkish Stock Markets in an APT Framework", *Martin-Luther-Universität Halle, Betriebswirtschaftliche Diskussionsbeiträge,* Nr. 48/2003.

Barberis, C., and Thaler, H. C. (2003), 'A Survey of Behavioural Finance.' In: George M. CONSTANTINIDES, Milton HARRIS, and Rene M. STULZ, eds. *Handbook of the Economics of Finance: Volume 1B, Financial Markets and Asset Pricing*. Elsevier North Holland, Chapter 18, pp. 1053-1128.

Brennan. J. M. (1971), "*Capital Asset Pricing and the Structure of Security Returns*." Unpublished Manuscript, University of British Columbia.

Brown, S. J. and M. I. Weinstein (1983), "A New Approach to Testing Asset Pricing Models: The Bilinear Paradigm", *The Journal of Finance*, Vol. 38, pp.711-744.

Bansal, R. and Viswanathan, S. (1993), No Arbitrage and Arbitrage Pricing: A New Approach, *Journal of Finance,* 48, 1231–1262.

Burmeister, E. and M. B. McElroy (1988), "Joint Estimation of Factor Sensitivities and Risk Premia for the Arbitrage Pricing Theory", *The Journal of Finance*, Vol.43, No. 3, pp.721-735.

Bodie, J. and, Kane, A. and Marcus, A. (2009), *'Investments.'* Publisher: McGraw-Hill Higher Education; 9e edition ISBN-13: 978-0071263252.

Basher, A. S. and Hassanb, K. M. and Islam, M. A. (2007), 'Time-varying Volatility and Equity Returns in Bangladesh Stock Market.' *Applied Financial Economics*, 2007, 17, 1393–1407.

Chiu, K. and Xu, L. (2004), 'Arbitrage Pricing theory-based Gaussian Temporal Factor Analysis for Adaptive Portfolio Management,' *Decision Support Systems* 37 (2004), 485– 500.

Chen, S. J. and Jordan, B. (1993), "Some Empirical Tests of the Arbitrage Pricing Theory: Macrovariables vs. Derived Factors", *Journal of Banking and Finance*, Vol. 17, pp. 65-89.

Cox, J., Ingersoll, J., Ross, S., (1985), An Intertemporal General Equilibrium Model of Asset Prices. *Econometrica* 53, 363–384.

Chen, N. (1983), "Some Empirical Tests of the Theory of Arbitrage Pricing", *The Journal of Finance*, Vol. 38, pp. 1393-1414.

Chen, N. F., R. Roll and S. Ross (1986), "Economic Forces and the Stock Market", *Journal of Business*, Vol. 59, pp. 383-403.

Cho, D. C., E. J. Elton and M. J. Gruber (1984), "On the Robustness of the Roll and Ross Arbitrage Pricing Theory", *Journal of Financial and Quantitative Analysis*, Vol. 19, No. 1, pp. 1-10.

Claude, B. E., and Harvey, R. C. and Viskanta, E. T. (1996), 'Political Risk, Economic Risk, and Financial Risk.' Source: *Financial Analysts Journal,* Vol. 52, No. 6, pp. 29-46.

Drew, E. M. and Naughton, T.and Veeraraghavan, V. (2003), 'Firm Size, Book-to-Market Equity and Security Returns: Evidence from the Shanghai Stock Exchange,' *Australian Journal of Management,* Vol. 28, No. 2.

Dhankar, P. and ESQ, M. (2005), "Arbitrage Pricing Theory and the Capital Asset Pricing Model Evidence Erom the Indian Stock Market." *Journal of Financial Management and Analysis,* 18(I): 14-27.

Dhrymes, P. J., I.Friend and N. B. Gultekin (1984), "A Critical Reexamination of the Empirical Evidence on the Arbitrage Pricing Theory", *The Journal of Finance*, Vol. 39, No.2, pp. 323-346.

Febrian, E and Herwany, A. (2010), "The Performance of Asset Pricing Models Before, During, and After an Emerging Market Financial Crisis: Evidence from Indonesia." *The International Journal of Business and Finance Research,* Vol. 4, No. 1.

Farmer, R. E. A. (2009), 'Confidence, Crashes and Animal Spirits', NBER working paper #14846, *National Bureau of Economic Research*, Cambridge, MA.

Flury, B. and Riedwyl, H. (1988), *Multivariate Statistics. A Practical Approach*. London: Chapman and Hall.

Fama, E . and MacBeth, J. (1973), "Risk, Return, and Equilibrium: Empirical Tests." *Journal of Political Economy*. 81: 3, pp. 607–36.

Fama, E. F. (1981), Stock Returns, Real Activity, Inflation, and Money, *American Economic Review*, 71, 545-65.

Fama, E. and French. R. K. (1992), "The Cross-Section of Expected Stock Returns." *Journal of Finance.* 47: 2, pp. 427–65.

Fama, E. and French, K. R. (1993), 'Common Risk Factors in the Returns on Stocks and Bonds', *Journal of Financial Economics*, Vol. 33, 1993, pp. 3–56.

Fama, E. and French, K. (1996), 'Multifactor Explanations for Asset Pricing Anomalies', *Journal of Finance*, Vol. 51, 1996, pp. 55–84.

Fama, F. E., and French, R. K. (2004), 'The Capital Asset Pricing Model: Theory and Evidence, *Journal of Economic Perspectives,* Vol. 18, No., pp. 25–46.

Ferreira, M. H. P and Rocha, R. A. (2002), 'An Autoregressive Approach of the Arbitrage Pricing Model to the Portuguese Stock Market.' *International Journal of Business*, 2002, Vol. 7, Issue 2, pp. 37-52.

Gehr, A. (1975), Some Tests of the Arbitrage Pricing Theory, *Journal of Midwest Finance Association*, pp. 91–105.

Grinblatt, M. and Titman, S. (2002, pp-186), '*Financial Markets and Corporate Strategy,"* (2nd edition), McGraw Hill Higher Education, NY 10020.

Ikbal and Aziz (2005), "Arbitrage Pricing Theory: Evidence from an Emerging Stock Market," Munich Personal RePEc Archive. Online at *http://mpra.ub.uni-muenchen.de/8699/ MPRA Paper No. 8699, posted 10. May 2008 / 10:45*.

Kandel, S., Stambaugh, R. (1987), On Correlations and Inferences about Mean Variance Efficiency. *Journal of Financial Economics* 18, 61– 90.

Kaul, G. (1987), Stock Returns and Inflation. The Role of the Monetary Sector, *Journal of Financial Economics*, 18, 253-276.

Lintner, J. (1965), The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets. *Review of Economics and Statistics* 47 (February): 13–37.

Lehman, B. N. and Modest, M. (1988), "The Empirical Foundations of the Arbitrage Pricing Theory", *Journal of Financial Economics*, Vol. 21, pp. 213-254.

Mei, J. (1993), "A Semiautoregression Approach to the Arbitrage Pricing Theory", *The Journal of Finance*, Vol. 48, pp. 599-620.

Michailidis, G. (2009), 'Multivariate Methods in Examining Macroeconomic Variables Effect on Greek Stock Market Returns, 1997-2004.' *Applied Econometrics and International Development*, 2009, Vol. 9, Issue 1.

Markowitz, H., (1952), Portfolio Selection. *Journal of Finance* 7, 77-91.

Martikainen, T., Yli-Olli, P. and Gunasekaran, A. (1991), Incremental Significance of Pre-specified Macroeconomic Factors in Testing the Arbitrage Pricing Theory: Empirical Evidence with Finnish Data, *Applied Financial Economics*, 1, 139-147.

Mollik, A. T. and Bepari, M. K. (2009), "Weak-form Market Efficiency of Dhaka Stock Exchange (DSE), Bangladesh (24 August, 2009)", *Proceedings of the 22nd Australasian Finance and Banking Conference*, Australian School of Business, The University of New South Wales, Sydney, available at SSRN: http://ssrn.com/abstract-1460536.

Mollik, T. A. and Bepari, K. M. (2010), 'Instability of Stock Beta in Dhaka Stock Exchange.' *Bangladesh Managerial Finance*, Vol. 36 No. 10, 2010: pp. 886-902.

Merton, R. C. (1973), "An Intertemporal Capital Asset Pricing Model." *Econometrica*. 41: 5, pp. 867–87.

Mossin, J. (1966), "Equilibrium in a Capital Asset Market." *Econometrica* 34, 768-83.

Ouysse, R. and Kohn, R. (2010), 'Bayesian Variable Selection and Model Averaging in the Arbitrage Pricing Theory Model,' *Computational Statistics and Data Analysis,* 54 (2010), pp. 3249-3268.

Ross, S. (1976), "The Arbitrage Theory of Capital Market Asset Pricing", *Journal of Economic Theory*, Vol. 13, pp. 341-360.

Ross, S. (1977), "Risk, Return and Arbitrage", *Risk and Return in Finance,* I, Friend, and J. Bicksler (Eds.), Balliner, Cambridge.

Roll, R., and Ross, S. (1980), An Empirical Investigation of the Arbitrage Pricing Theory. *Journal of Finance* 35: 1073-1103.

Ross A. S. (1984), 'Reply to Dhrymes: APT is Empirically Relevant.' *The Journal of Portfolio Management Fall* 1984, Vol. 11, No. 1, pp. 54-56.

Sharpe, W. F. (1964), "Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk", *Journal of Finance*, Vol. 19, pp. 425-442.

Shanken, J., (1982), The Arbitrage Pricing Theory: Is it Testable. *Journal of Finance* 37, 1129–1140.

Shanken, J., (1985), Multi-beta CAPM or Equilibrium APT?: A Reply. *Journal of Finance* 40, 1189– 1196.

Shanken, J., (1987), Multivariate Proxies and Asset Pricing Relations: Living with the Roil Critique. *Journal of Financial Economics* 18, 91–110.

Shanken, J., (1992), The Current State of the Arbitrage Pricing Theory. *Journal of Finance* 47, 1569–1574.

Shanken , J. and Weinstein, I. M. (2006), 'Economic Forces and the Stock Market Revisited.' *Journal of Empirical Finance* 13 (2006), 129–144.

Shiller, R. (1981), "Do Stock Prices Move too Much to be Justified by Subsequent Changes in Dividends?", *American Economic Review* 71: 421-436.

Shiller, R. (1984), "Stock Prices and Social Dynamics", *Brookings Papers on Economic Activity* 2: 457-498.

Shiller, R. and Beltratti, A. (1993), "Actual and Warranted Movements in Asset Prices" Beltratti, A., *Oxford Economic Papers* (1993), 45: 387–402. [CFDP 970, CFP 859].

Shiller, J. R. (2005, pp. 110-118), *Irrational Exuberance:* Second Edition, Publisher: Princeton University Press; 2nd edition (22 Feb 2005) ISBN-13: 978-0691123356, pp. 172-176.

Selden, G. C., (1912), *Psychology of the Stock Market: Human Impulses Lead To Speculative Disasters.* New York: Ticker Publishing.

Sewell, M. (2007), *'Behavioural Finance.'* Available at *http://www.behaviouralfinance.net/behavioural-finance.pdf*

Shukla, R. K., and Trzcinka, A. C. (1990), Sequential Tests of the Arbitrage Pricing Theory: A Comparison of Principal Components and Maximum LikelihoodFactors, *Journal of Finance*, 45, 1541–1564.

Subrahmanyam, A. (2010), 'The Cross-Section of Expected Stock Returns: What Have We Learnt from the Past Twenty-Five Years of Research?' *European Financial Management*, Vol. 16, No. 1, 2010, 27–42.

Türsoy, T. and Günsel, N. and Rjoub, H. (2008), 'Macroeconomic Factors, the APT and the Istanbul Stock Market,' *International Research Journal of Finance and Economics ISSN 1450-2887 Issue 22*.

Zhang, X. and Wang, Z. (2006), 'Empirical Evaluation of Asset Pricing Models: Arbitrage and Pricing Errors over Contingent Claims.' *Paper Provided by Federal Reserve Bank of New York in its series Staff Reports with number 265*. Postal: 33 Liberty Street, New York, NY 10045-0001 *Management Science*, Vol. 55, No. 7, July 2009, pp. 1255-1266.

Zhongzhi L. H, and Huh, S. and Lee, B. (2010), 'Dynamic Factors and Asset Pricing.' *Journal of Financial and Quantitative Analysis* Vol. 45, No. 3, pp. 707–737.

International Financial Statistics (database) available online at *http://www.imfstatistics.org/imf/* Dhaka Stock Exchange available *at www.dsebd.org* Bangladesh Bank –Monthly Economic Trends (data achieve) available at *http://www.bangladesh-bank.org/*