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ASSET PRICING PUZZLE: NEW EVIDENCE OF FAMA-FRENCH FIVE-FACTORS IN EMERGING MARKET PERSPECTIVES

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Abstract

The asset pricing theory introduced by Fama and French (2015) documents five systematic common risk factors for equity valuation, such as: (a) market beta, (b) firm size, (c) firm value, (d) profitability and (e) investment strategy. However, corporate finance literature does not provide us with a particularly robust check if the FF5 model is equally exposed to estimate equity returns in an emerging market. Hence, based on Fama and Macbeth (1973) as well as Fama and French (1993, 2015, 2020), this paper applies multivariate regression (time series & cross-sectional) analysis for the robust test of common risk factors and risk premia respectively in an emerging market context, and finally validates that all of the systematic risk factors are significant except firm profitability and investment strategy. We found that the distinguishing semi-strong level of market efficiency influences the explanatory power of the underlying risk exposure for stock return performance differently in an emerging market. The finding could be important in estimating equity fair pricing that is yet to be examined for an emerging market. Therefore, with the reconfirmedthree significant common risk factors, the market practitioners, policy makers, financial analysts, and, above all, investors can estimate equity value appropriately, and thereby take optimal financial and investment decisions.

Key words: *asset pricing theory, systematic risks FF5 model, security pricing, time series, cross-sectional analysis*.

JEL Classifications: *G3, G12*.

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1. Introduction

The valuation puzzle on identifying the inherent common risk factors of security pricing seems to be one of the core issues of asset pricing theory. In finance literature, the investment theory (Markowitz, 1952, 1959) sheds new light and a break-through paradigm shift in the proposition of modern asset pricing theory.The arbitrage pricing theory (APT), which is widely known as multi-factor asset pricing, was first introduced by Ross (1976). Consequently, based on the multi-factor asset pricing model, Fama and French (1993) initially anticipated and documented a three-factor model for pricing stock, with the identified three underlying factors of equity pricing being: (a) market beta, (b) firm size, and (c) firm value. Later on, Fama and French (2015) extended the initial proposed model of stock valuation by including two more systematic common risk factors: (a) firm profitability and (b) investment strategy.

Based on existing corporate finance literature, we find that the asset pricing models developed by Fama and French (2015) offer relatively higher explanatory power for security return performance. To examine the proposed model robustness, Fama and French (2017) recheck their study findings in the

context of the global market, and document that the five-factor model can estimate return abnormalities across different regions around the globe, particularly if the market is a weak form of efficient market. Hence, we assume that the model performance might differ from region to region around the globe; for instance, Racicot and Rentz (2017) recently document that the feasibility and significance of the FF five factors model is highly variable and market efficient. In addition, we find that the finance researchers are continuing to examine the validity of asset pricing variables as well as making efforts to find the unaddressed variables to further explain the cross-section of asset returns. Despite the available research on equity pricing, we notice that there is not yet an appropriate robust test and guideline on executing the FF5 factors pricing model in an emerging market context. According to efficient market hypothesis (EMH), the distinguishing features and behavior of an emerging market is different from those of counterpart developed or underdeveloped markets. In this respect, we argue that it may or may not be appropriate to conduct share valuation in an emerging market based on the Fama and French (2015) asset pricing propositions. We consider that the equity pricing in an emerging market might require a measurement of respective risk premium higher than the risk-free rate from an underlying systematic common risk factor, which might not be ideally concomitant to a developed market (Huang, 2019; Ragab et al., 2020; Yin & Wei, 2020). There continues to be ongoing debate on examining the underlying risk factors for equity valuation in an emerging market perspective.

We find that Bangladesh shares are regularly traded on either the Dhaka stock exchange (DSE) or the Chittagong stock exchange (CSE). Due to different market mechanisms, regulations, and financial barriers, the trading of the stock exchange usually affects the explanatory power of different asset pricing techniques. Hence, we believethat the Dhaka stock may pose an interesting study because of its obvious differences from conventional capital markets across different regions, particularly in terms of market efficiency, structures, government regulations, financial systems, information asymmetry, the signaling effect and investor composition. Moreover, we find that DSE has undergone rapid changes since its foundation in 1954. A number of recent strategic patterns like share-structure reform have caused notable structural breaks in DSE. Hence, there is a research question if the common risk factors provide consistent prediction for stock return across different markets and areas of industry. The fact is that a good asset pricing approach must theoretically capture all the associated securities, irrespective of the portfolios or the individual stocks (Fama & French, 2020). Hence, in this study, we reassess the FF5 model based on the new emerging market of Bangladesh.

In this research, we enrich the existing asset pricing literature by adopting stock return performance in lieu of portfolio return performance as the dependent variable. In particular, this study employs firm-level data over the period from Jan. 2010 to Dec. 2019 of Dhaka Stock Exchange, Bangladesh. The overall test results for 560 stock-by-stock time-series regression analyses show that the average coefficients for excess market return, firm size, firm value, firm profitability and investment strategy are 0.41, 0.31, 0.35, 0.19, and 0.27 respectively. The risk factor loadings of excess market return, firm size, and firm value are statistically significant at the level of less than five percent, whilst the risk factor loadings of firm profitability are statistically significant at the level of less than ten percent. The risk factor loading of investment strategy, however, is statistically insignificant. In the second phase of cross sectional regression, the findings from cross sectional regression analysis prove that the average level of risk premia for market return, firm size, firm value, firm profitability and investment strategyare 3.12%, 1.59%, 1.19%, 0.82% and 0.1% respectively, and all of them except for firm profitability and investment strategy are statistically significant at the level of ten percent. The overall conclusions are stable for all subsample reviews. Overall, the results show that stock returns in Bangladesh are strongly linked to the equity market, firm size, and firm value effect, but insignificantly to firm profitability and investment factor. In summary, this implies that the three common risk factors are applicable irrespective of the equity index in the capital market of Bangladesh.

This study has significant novelty and academic contribution that systematically conducts comparative performance analysis among the different existing modern security pricing models, for instance, CAPM (Sharpe, 1964; Lintner, 1965), Fama and French (1993) FF3 model, Carhart (1997) four-factor model, and finally Fama and French (2015) FF5 factors model. Specifically, the study runs regressions for each equity and finds that FF5 (2015) can explain the highest 36.45% variation in the excess returns on individual stocks in Bangladesh. This remark is consistent in the claim that the FF5

factors model is superior to other available asset pricing models when explaining stock return. and that the explanatory power of the five-factor model is slightly higher than other conventional models (Huang, 2019; Fama and French, 2020). However, we confirm that the risk drivers of investment and profitability factors are statistically insignificant and that the addition of investment and profitability factors only slightly improves model performance. This finding refers that both factors offer incremental but insignificant explanatory power for equity returns in Bangladesh.

This empirical result is relevant, important, and original, which is yet to be tested in finance literature on Bangladesh perspectives. The reason is that this study with empirical evidence initially attempts to examine the extent to which the Fama and French Five factors model explains returns in developing countries, using the Bangladesh stock market as an example. It documents that the investment and profitability factors have limited explanatory power. This empirical result is of course important, which is yet to be tested in finance literature in the Bangladesh context. To the best of our knowledge, no prior empirical study on asset valuation has examined this fundamental research question yet, whilst an answer to the question is required if we wish to conduct a robust check of the Fama and French (2015) pricing model based on emerging market perspectives. This is important because the explanatory power of the FF5 model in an emerging market might be different in relation to other counterpart markets. Hence, we will know for the first time if FF5 is robust in an emerging market. Thus, the financial analysts and practitioners can now assess the risk level of individual stock more accurately and determine its fair value in an emerging market. In addition, the three reassessed and validated common stock risk factors would help financial analysts to examine the assessment criteria based on which they require a rating scale for appropriate performance appraisal. Overall, this research is pioneering when it comes to exploring common risk factors within the framework of the asset pricing theory in the context of an emerging market.

We organize the rest of the paper as follows: in the next section, we provide relevant theoretical discussions and a literature review on the underlying systematic common risks of Fama and French (2015). Then, the sample characteristics, empirical results and findings are explained. The conclusion is also provided in the last section of the manuscript.

2. Literature review

Simply understood, security valuation is a quantitative technique to estimate the value of a company's security that varies on the basis of market demand and supply. The dispute over what decides the return of a security is among the central debates of capital market theory. Based on underlying common risk factors, stock valuation based on fundamentals aims to give an estimation of the intrinsic value of a stock (Uddin et al., 2020). Researchers have long sought to identify risk factors that systematically affect the returns of common stocks. A number of asset pricing models are proposed to estimate and analyze the return behavior for the global stock market. Among the prior studies, the FF5 asset pricing model of Fama and French (2015) draws a great deal of applications and attention in finance literature on asset pricing. Therefore, the significance in the application of the FF5 model has been on the rise among both researchers, analysts and practitioners. We now briefly discuss the identified Fama French (2015) five risk factors, and relevant literature analysis respectively in the following sections of (a) and (b).

a) The Underlying Risk Factors

As discussed earlier, the underlying common risk factors of a particular share should determine its specific returns to the investors. It functions as a complement of a corresponding systematic risk factor for additional risk premium to the equity owners. Based on existing corporate finance literature, let us first of all discuss the idiosyncratic risk factors of the Fama and French (2015) model.

1) Market Risk Factor

In simple, the risk premium of a share is estimated by the degree of sensitivity of a share with all equity market; and ,therefore, the movement of the equity market requires a significant risk premium for share valuation (Levi & Welch, 2020; Michala, 2019).It implies that it is possible to estimate a "share beta" that captures the sensitivity of an individual share price with respect to the changes in the average prices of all equity indexes. So, the market momentum significantly affects the security return performance. Hence Kim (2021) argued that an actual security trading between

buyer and seller is usually considered to provide the best market indicator as to the "true value" of securities at that particular time.

Based on finance literature, we find that CAPM identifies an efficient portfolio as the market portfolio – a portfolio of all underlying securities in the market which is considered a fully diversified portfolio (Bai et al. 2019; Huang, 2019; Sharpe, 1964). We find that the risk premium of a security is equal to the market risk premium multiplied by the amount of market risk present in a security's returns, measured by its beta with the market. Hence the CAPM assumes market as the only single factor influencing returns on securities. In finance, arbitrage pricing theory (APT) holds that expected return of a financial instrument is modeled as a linear function of various systematic risk factors or unavoidable theoretical market indices (Kleibergen & Zhan, 2020; Hartman-Glaser et al., 2019; Ross, 1976). In summary, we frame the expected return on a share under the following multifactor asset pricing theory:

$$E(R_i) = R_f + \beta_1(r_1 - r_f) + \beta_2(r_2 - r_f) + \beta_3(r_3 - r_f) \ldots + \beta_n(r_n - r_f) + \varepsilon_t \quad (1)$$

2) Size Risk Factor

We find that "*firm size*" estimates market capitalization (share prices multiplied by outstanding shares) of the corresponding firm. In this respect, the Fama and French (1993) states that document that small equities (those with lower market capitalization) have higher average returns (positive alphas above the SML), and big equities (those with higher market capitalization) have low average returns (negative alphas below the SML). This portfolio is represented by the SMB (Small Minus Big). Most recently, Alfaro et al. (2019) validate that firm size plays a significant role in the relationship with firm leverage, firm fragility and exchange rate movements in emerging markets. While the relationship between firm-leverage and financial distress scores varies over time, the relationship between firm size and corporate vulnerability is relatively time-invariant. The asset pricing theory therefore assumes that the small-minus-big firm market capitalization requires a significant risk premium for introducing secure fair valuation (Dang et al. 2018).

3) Value Risk Factor

The firm value indicates the ratio of the book value of equity to the market value of equity. In this context, the Fama and French (1993) state of document that equities with high book-to-market ratios exhibit high average returns (positive alphas above the SML) and low book-to-market ratios exhibit low average returns (negative alphas below the SML); and this portfolio is represented by the HML (High Minus Low) portfolio. A number of recent studies, such as Taussig and Klein (2021), Bhaskaran and Sukumaran (2021) document that "firm value" implying book-to-market ratio requires a significant risk premium for an appropriate security pricing.

4) Profitability Risk Factor

Fama and French (2015) identifies that a firm profitability factor (RMW: robust-minus-weak) is also a systematic common risk factor of asset pricing theory. Putting it simply, the measure of a firm's operating profitability is annual revenues minus the costs of goods sold, interest and other general and administrative expenses during the previous fiscal year divided by the end book value of equity. Most recently, Hui et al. (2019) find that the major customer concentration is negatively associated with the supplier firm's profitability, but positively associated with the major customers' profitability. In this respect, Appio et al. (2019) argued that the relationship between patent portfolio diversity and profitability is non-linear and differentially moderated by both, the level of non-self forward and backward citations.

5) Investment Risk Factor

Fama and French (2015) document that firm investment strategy as a systematic common risk factor requires a substantial risk premium for share valuation. In this respect, the authors estimate firm investment strategy by changing the dynamics of the book value of total assets from the beginning to the end of the prior period divided by the earlier ending book value of total asset. The study conducted by Jehiel (2018) postulates that when higher signals are associated with higher returns, investors are overly optimistic, which in turn results in overinvestment. Rational investors increase the overoptimism of sampling investors, thereby illustrating a negative externality

imposed by rational investors. In addition, Hui *et al.* (2019) find that, despite diminishing anomalies in recent decades, the investment strategy or price momentum is persistent in the global market; and the mispricing-based strategy performs better in periods of high investor sentiment. Based on the above discussion, let us summarize the definitions of the associated variables used in this study:

1. Market index (MKT) is an abbreviation for the all equity index. Market factor is equal to the all equity return minus risk-free rate.
2. Size factor (SMB) is an acronym for "small-minus-big". Based on market capitalization, all the firms are categorized into small and big groups by using median market value of the test bed.
3. Value factor (HML) is an acronym for "high-minus-low". We divided all firms into three groups based on the 30th & 70th percentile of Book-to-Market ratio.
4. The profitability (RMW) aspect refers to corporate financial performance; here, RMW is the abbreviation for Robust-Minus-Weak. Here, the estimation of operating profitability is annual revenue minus the costs of goods sold, interest and other operating expenses divided by the end book value of an equity (Fama and French, 2015). The portfolio recommends that the 30th and 70th percentile provide the breakpoint point in the test bed.
5. The firm investment determinant (CMA); here, CMA is an acronym for conservative-minus aggressive. CMA refers to the dynamics of book value of total assets from the beginning to the end divided by the ending book value of the total assets. It is in line with the HML factor portfolio; thus, the 30th & 70th percentiles indicate the data breakpoint.

b) Review Analysis:

To address the research issue, we considered the fundamental framework and underlying risk z. Therefore, it is highly debatable whether Fama French (2015) five factors function well in DSE. The reason is that we are not sure if the Fama and French (2015) five-factor presents consistent or variant predictions in an emerging market. Accordingly, this study attempts to address the particular research agenda in the regime of corporate finance literature.

3. Sample and Data Description:

The Dhaka stock market has been experiencing dramatic momentum since its foundation in 1954, back when it had approximately 750 listed firms. As stated earlier, this study reasseses the Fama and French five factors pricing model and also empirically tests the model with weekly return over a period of 10 years, from January 2010 to December 2019. We consider that the Dhaka stock exchange data has special significance as new emerging market perspectives. The test set of the selected firms are collected from different secondary sources, which includes Thomson Reuters Eikon (a global database) and also relevant reports, and analyses published by the DSE. We checked and included only those firms having the required test data of a minimum of one year over the period of January 2010 to December 2019. Out of around 750 DSE listed firms, after the final data mining, the study sample is reduced to 360 firms. The reason is that we excluded all the firms having data sets of less than one year. We believe that the sample is relevant, representative and appropriate for this study, because we intend to examine the research issue in an emerging market setting. The sample distributions across different dimensions are presented below in Table 1, in which Panel A provides the distribution by industry types, and Panel B presents the distribution by issuer categories.

From Panel A, we find that, out of 360 sample shares, a total of 55 shares (15.28%), 48 shares (13.33%) and 45 shares (12.5%) are from the respective industry areas of trade-service, consumer products and industrial products. The remaining sample shares belong to the industry areas of Transportation & Logistics, IT Sector, Plantation & Agro-sector, Fuel & Power, Pharmaceutical, Real Estate and the Construction sector. Next, Panel B shows that a total of 310 (86.11%) are non-govt owned firms, whereas the remaining 50 (13.89%) are government owned firms. This is to note that we retrieves the available daily, weekly, and monthly return data for 360 securities ove the period of January 2010-December 2019, resulting in a total of 2940 daily, 420 weekly, and 120 monthly observation.

Since the test results of this paper are primarily based on secondary sources of test set, we present their descriptive statistics in Table2. We find that panel A presents the mean value, standard deviations, median, maximum, minimum, skewness and kurtosis, whereas panel B shows the

correlations among these factors. We analyze that the mean of market excess returns is 0.96% for each month. Hence, the value-weighted market portfolio return performances are higher than risk-free rate in the market. The annualized excess return equals 11.40%, referring that the Dhaka stock market experiences an upward trend over the sample period. However, the trend is volatile as the standard deviation has a relatively higher value of 21.80% per-month. In addition, the size effect indicates to the property that smaller firms tend to provide relatively higher returns than than larger firms. We analyze that the average return on the size factor SMB is 0.87%, which is slightly less than the market factor. The value effect indicates the pattern in which value stock with a high book-to-market ratio is supposed to outperform growth stock with lower ones. In contradiction to the analysis, the HML value factor has a mean of 0.23% per month, with a standard deviation of 14.69%. Overall, the significant t-statistic indicates that stocks in the Dhaka stock market suffer from several systematic risks. However, profitability, and investment strategy are identified relatively weak in the Dhaka stock market. From the econometrics point of view, the low t-statistic indicates that the spread and effect of firm profitability and investment strategy are indistinguishable; and therefore, the effects caused by these two common risk factors are trivial to the investors in the DSE capital market.

Table 1

Sample Distribution of Equity from DSE (N=360)

Panel A: Classification by industry type

Industry Type	No	%	Industry type	No	%
Transportation & Logistics	28	7.78%	Real Estate	35	9.72%
Consumer product	48	13.33%	Construction	27	7.51%
IT Sector	32	8.89%	TOTAL	360	100
Plantation &Agro-sector	26	7.22%	**Panel B: Classification by issuers/originators**		
Fuel & Power	34	9.44%			
Industrial product	45	12.5%	Govt. Firms	50	13.89%
Trade-service	55	15.28%	Non-Govt. Firms	310	86.11%
Pharmaceutical	30	8.33%	TOTAL	360	100%

Here we present the distribution of sample across different industry areasand issuer categories in panel A and panel B respectively over the January 2000-December 2019 period.

Source: own study.

Table 2

Descriptive Analysis

Panel A. Summary statistics

Variables	Median	Mean	Std.Dev	Minimum	Maximum	Kurtosis	Skewness	*t*-stat
MKT	0.172	0.96	21.80	-.0126	1.19	0.79	1.53	1.98**
SMB	0.149	0.87	15.10	-.051	1.04	1.74	2.32	2.49***
HML	0.112	0.23	14.69	-.022	0.99	1.12	1.75	1.83*
RMW	0.085	0.21	18.60	-.006	0.79	2.71	2.01	0.66
CMA	0.064	0.12	26.49	-.046	0.54	2.56	2.52	0.73

Panel B. Correlation Matrix among FF5 Factors Model

Variables	a.MKT	b.SMB	c.HML	d.RMW	e.CMA
a.MKT.	1				
b.SMB.	0.331	1			
c.HML.	0.517	-0.521	1		
d.RMW.	0.062	-0.018	0.0352	1	
e.CMA.	0.541	0.604	-0.505	-0.642	1

The above statistics are based on a total of monthly observations for listed 360 equities ofDSE across the data set for the period of January 2010-December 2019.

Source: own study.

In the next phase, Panel B of Table 2 documents the correlation of the asset pricing factors. As a whole, the underlying FF5 factors (MKT-SMB-HML-RMW-CMA) are correlated on a moderate measurement scale. Hence, we do not detect any multicollinearity issues in our test models. We find that the SMB or size factor is positively correlated with MKT and CMA; however, inversely correlated with HML and RMW. It is logical that small stock tend to be growth stock, with low B/M ratio, weak profitability, as well as lower investment. The positive correlation between HML and RMW (0.0352), and the negative correlation between HML and CMA (-0.505) imply that high B/M firms tend to be financially attractive and antagonistically invested. In addition, as profitable firms tend to invest more, they eventually examine why RMW is strongly but negatively correlated with CMA with underlying correlations of 0.642. We analyze that the estimates of the correlation matrix are not completely consistent with Guo et al. (2017), Fama and French (2017, 2020). We should therefore be careful in interpreting the relationships among the underlying common risk factors of asset pricing. The underlying correlations among the risk factors are found to vary when a different sample period is executed in the study. This means that the correlation matrix could be insightful to the right sample selection strategy. We therefore believe that the sampling strategy and investment timing may be very important for appropriate investment decisions.

4. Test Results and Analysis

As stated earlier, asset pricing literature has not yet assessed if the Fama and French (2015) five factor model functions appropriately in an emerging market, particularly that of Bangladesh. Hence, in this study, based on the Fama and French five factor model, we estimate the excess return of a stock by considering the time series model of: $R_t - R_{ft} = a + b_1[R_{mt} - R_{ft}] + b_2 SMB_t + b_3 HML_t + b_4 RMW_t + b_5 CMA + e_t$. In this equation, we find that $R_t - R_f$ is the excess return of security for the period t, $R_m - R_f$ is the stock market excess return, SMB is the size factor- an acronym for "small-minus-big"; HML is the value factor - an acronym for "high-minus-low"; RMW is the profitability factor - an acronym for "robust-minus-weak"; and finally CMA is the investment factor - an acronym for conservative minus aggressive. Having identified (a) market index, (b) firm size, (c) firm value, (d) profitability and (e) investment strategy, we estimate the equity risk factor loadings b_1, b_2, b_3, b_4, $and\ b_5$ - for an individual security by running the time series regressions. Afterwards, following the Fama and Macbeth (1973) approach, we estimate the expected risk premia for the five risk factors by running month-by-month cross-sectional regressions over the period of Jan. 2000 to Dec. 2019. We consider the cross-sectional regression of: $(R_{it} = \Upsilon_{0t} + \Upsilon_{1t}\hat{b}_{1i} + \Upsilon_{2t}\hat{b}_{2i} + \Upsilon_{3t}\hat{b}_{3i} + \Upsilon_{4t}\hat{b}_{4i} + \Upsilon_{5t}\hat{b}_{5i} + \eta_{it})$; where, Υ_{1t}, Υ_{2t}, Υ_{3t}, Υ_{4t}, Υ_{5t} might provide us with the expected risk premia for the Fama and French five common risk factors as considered in time series regression. Hence, the coefficient estimates Υ_{1t}, Υ_{2t}, Υ_{3t}, Υ_{4t}, , Υ_{5t} - provide us with the expected risk premia of: (a) market index, (b) firm size, (c) firm value, (d) profitability and (e) investment strategy. If the mean values of the five coefficients from cross sectional regressions are supposed to be significant, then we infer that security investors require a premium or compensation for accepting common risks of: (a) market index, (b) firm size, (c) firm value, (d) profitability and (e) investment strategy.

a) Time Series Regressions

As stated earlier, based on Fama & Macbeth (1973), we execute time series regressions before conducting cross sectional regression. In order to execute the time series and cross sectional regression, we run the mathematical model of- $Y_t - RF_t = a + b_1[R_{mt} - R_{ft}] + b_2 SMB_t + b_3 HML_t + b_4 RMW_t + b_5 CMA + e_t$- for 360 DSE listed shares. Here we intend to estimate underlying factor loadings of five common factors (a) market index, (b) firm size, (c) firm value, (d) profitability and (e) investment strategy, estimated by b_1, b_2, b_3, b_4, and b_5 respectively. For instance, b_5 determines the sensitivity of a corresponding security to the investment strategy. The average factor loadings (b_1, b_2, b_3, b_4, $and\ b_5$) of 360 DSE listed securities are presented in Table3. We observe that the average values of b_1, b_2, b_3, b_4, $and\ b_5$ for all securities are 0.41, 0.31, 0.35, 0.19, and 0.27 respectively. We found that the coefficients of market index, firm size, and firm value are statistically significant at the level of less than five percent. In addition, the coefficient of firm profitability is significant at the level of ten percent; however, the remaining coefficient of firm investment strategy (b_5) is not statically significant whatsoever. These findings support the initial hypothesis that the changes in the market index, firm size, firm value, and firm profitability significantly influence the level of security return. Based on our

first step analysis of time series regression, our empirical study discloses that these four risk factors are highly important for estimating the returns of securities in the Dhaka stock exchange.

Table 3

Time series regressions across all equity, industry types & issuer types (Fama & Macbeth, 1973)

SECURITY	ALPHA	MKT	SMB	HML	PROFIT	INV.ST	DW	R^2	F	N
All EQUITY	0.011 (*0.041*)	0.41 (*0.011*)	0.31 (*0.032*)	0.35 (*0.042*)	0.19 (*0.091*)	0.27 (*0.212*)	2.04	0.295	34.25 (*0.00*)	360
Transportation & Logistics	0.017 (*0.087*)	0.23 (*0.023*)	0.24 (*0.042*)	0.31 (*0.0040*)	0.112 (*0.101*)	0.321 (*0.312*)	2.09	0.161	31.22 (*0.00*)	28
Consumer product	0.024 (*0.098*)	0.32 (*0.027*)	0.53 (*0.024*)	0.38 (*0.039*)	0.44 (*0.085*)	0.28 (*0.142*)	2.01	0.195	24.25 (*0.00*)	48
IT Sector	0.011 (*0.024*)	0.11 (*0.081*)	0.14 (*0.052*)	0.76 (*0.043*)	0.65 (*0.097*)	0.25 (*0.126*)	1.97	0.391	23.27 (*0.00*)	32
Plantation & Agro sector	0.021 (*0.024*)	0.41 (*0.011*)	0.31 (*0.032*)	0.35 (*0.046*)	0.19 (*0.097*)	-0.217 (*0.412*)	2.07	0.233	14.5 (*0.00*)	26
Fuel & Power	0.061 (*0.064*)	0.41 (*0.011*)	0.31 (*0.032*)	0.35 (*0.046*)	0.28 (*0.097*)	0.217 (*0.316*)	2.06	0.275	34.51 (*0.00*)	34
Industrial product	0.011 (*0.034*)	0.41 (*0.011*)	0.39 (*0.021*)	0.35 (*0.046*)	0.19 (*0.067*)	-0.217 (*0.231*)	1.94	0.216	22.56 (*0.00*)	45
Trade-service	0.011 (*0.094*)	0.48 (*0.008*)	0.31 (*0.032*)	0.35 (*0.046*)	0.19 (*0.087*)	0.217 (*0.293*)	2.04	0.165	24.56 (*0.00*)	55
Pharmaceutical	0.024 (*0.098*)	0.32 (*0.027*)	0.53 (*0.024*)	0.31 (*0.032*)	0.24 (*0.115*)	0.28 (*0.142*)	1.99	0.391	33.4 (*0.00*)	30
Real Estate	0.016 (*0.024*)	0.128 (*0.081*)	0.14 (*0.052*)	0.76 (*0.043*)	0.65 (*0.10*)	0.25 (*0.112*)	2.08	0.194	34.21 (*0.00*)	35
Construction	0.011 (*0.014*)	0.78 (*0.011*)	0.75 (*0.032*)	0.35 (*0.046*)	0.17 (*0.096*)	0.298 (*0.212*)	2.05	0.232	18.9 (*0.00*)	27
Govt. Owned Firms	0.024 (*0.065*)	0.23 (*0.023*)	0.24 (*0.042*)	0.31 (*0.040*)	0.112 (*0.101*)	0.321 (*0.312*)	2.02	0.276	24.9 (*0.00*)	50
Non-Govt. Owned Firms	0.431 (*0.074*)	0.761 (*0.015*)	0.751 (*0.031*)	0.64 (*0.046*)	0.49 (*0.147*)	0.548 (*0.171*)	2.06	0.255	33.67 (*0.00*)	310

The results of Time Series Regressions across all equities; different types & issuer categories are presented in the above Table. We reassess the significance of the average factor loadings (using time series coefficient) for FF5 Factors. Coefficient p-values are reported in parentheses. We find consistent results in subsample analysis. Generally, time series returns are serially correlated; hence, we apply Cochrane & Orcutt (1949) to correct the auto correlation issue in time series data analysis.

Source: own study.

We also found that the explanatory power of the model is 29.5%, because the average R^2 of the five factor model is 0.295 of security returns. As a whole, the time-series regressions with five risk drivers work well for all securities, as is evident from the average F value of 34.25. In addition, we find that the average DW table value is 2.04, which is close to the standard value of 2 for having no autocorrelation in the model. Reviewing the break-up results for the different types of securities across different industries and issuers, we find that the average coefficient values of $\boldsymbol{b_1}$, $\boldsymbol{b_2}, \boldsymbol{b_3}$ - are statistically significant in all cases, at a significance level of 5%, though there is variation of the coefficient of $\boldsymbol{b_4}$,which is significant at the ten percent level of significance in several industry sectors, such as: Transportation & Logistics, Consumer product, IT Sector, Plantation & Agro sector, Fuel &

Power, Industrial product, and Trade-service. This is interesting, because the significance of firm profitability does not persist across all the industries. However, the coefficient of $\boldsymbol{b_5}$ which is not significant in any subsample analysis. This implies that investment strategy is not broadly exposed to require a significant level of additional risk premium as a systematic risk factor for security pricing. Nonetheless, all other determinants might prevail, because the intercept (alpha) is positive and statistically significant for all test models.

b) Cross Sectional Regressions

In the earlier section of time series regression, we find that the security pricing of DSE listed firms has four out of five statistically significant common risk factors, although firm profitability is significant at the significance level of ten percent. As a consequence, we proceed to determine if investors need risk premium against the risk factors. We followed the Fama and Macbeth (1973) model and determined, month-by-month, cross-sectional regressions ($Y_{it} = Y_{0t} + Y_{1t}\hat{b}_{1i} + Y_{2t}\hat{b}_{2i} + Y_{3t}\hat{b}_{3i} + Y_{4t}\hat{b}_{4i} + Y_{5t}\hat{b}_{5i} + e_{it}$); where, Y_{1t} , $Y_{2t}Y_{3t}$, Y_{4t}, Y_{5t} might provide us with underlying risk premia for the Fama and French five common risk factors. The findings reported in Table 4 provide that the average values of: Y_1, Y_2 , $Y_3$for all 360 securities are respectively 0.0324, 0.0118, 0.01959, which are significant at the level of five percent. This means that an increase in the market risk by one unit may require an additional 3.24% premium, while a one-unit increase in small minus big risk needs approximately 1.18% premium, and a one-unit increase in high minus low requires approximately 1.95% premium for the investors in the new emerging market of Bangladesh. However, the interesting finding is that the average values of Y_4, and $Y_5$for all 360 securities are 0.0235 and 0.0127 respectively, which are not statistically significant, though the factor loading of firm profitability in the time series analysis is significant at the level of ten percent. This remark is consistent with the recent study findings and analysis of Fama and French (2020), Taussig & Klein, (2021), and Bhaskaran & Sukumaran (2021).

The finding of cross-sectional analysis for an emerging market perspective is very important and interesting for adopting the Fama and French asset pricing theory. Based on overall time series and cross sectional regression, we confirm that the common risk factors of (a) market index, (b) firm size, and (c) firm value are significant for pricing security in the emerging stock market of DSE. In this respect, we do not find any reason to consider five factors for the DSE context, because the risk factors of profitability and investment strategy are not significant, as discussed earlier. Let us now look at the average intercept (Y_0) of the cross-sectional models and clearly understand that there might have been other equity risk factors in addition to the factors of (a) market index, (b) firm size, (c) firm value. This is because the average value of Y_0 is statistically significant at the five percent level. With these results, we document that the common asset risk factors of: (a) market index, (b) firm size, (c) firm value require a noteworthy risk premium for the investors of DSE. These findings on security risk premia are generally consistent across all types of securities under different industry sectors, and govt. affiliation categories, such as Govt. Owned Firm, and Non-Govt. Owned Firms in Bangladesh.

On the whole, our academic novelty based on time series and cross sectional regression validates that, out of Fama French five factors, three factors play a statistically significant role to execute security fair pricing on the Dhaka stock exchange, Bangladesh. These three common factors have statistically significant risk premia for equity investments in DSE. We critically evaluate that, although the study executes time series and cross sectional regression analysis, as originally developed by Fama-Macbeth (1973), the finding is in line with prior studies, such as: Huang (2019), Yin and Wei (2020), Taussig and Klein (2021) and Bhaskaran and Sukumaran (2021). These studies also checked the robust test of Fama and French Five factors model. Therefore, we remark that regular returns on firm profitability and investment strategy are insignificant for the Dhaka stock exchange, Bangladesh.

We conduct a robust check of the feasibility of the FF5(2015) model in the Dhaka stock market in phase d. Adding profitability (RMW) and investment strategy (CMA) to the three-factor model, the FF5 is executed for estimating average returns related to size, value, profitability, and investment (Fama &French, 2015). Interestingly, we analyze that profitability (RMW) and investment (CMA) factors added to the FF3 model are statistically insignificant; however, the adjusted-R^2 of the FF3 equation marginally improves after adding RMW and CMA for the Dhaka stock exchange. From an econometric point of view, this is a common finding of multiple asset pricing models. Hence, we cannot claim and prove that FF5 asset pricing model performs significantly better than that of FF4 (Carhart, 1997) or FF3 (Fama and French, 1993) in terms of adj-R^2 or the significance level of model coefficients. However, these two new factors add insignificant explanatory power to the Dhaka stock

market. The coefficient on RMW documents that, due to 1% momentum in profitability, leads to an additional 0.195% excess return of asecurity, and is statistically insignificant. In the same vein, the investment factor (CMA) possesses a statistically insignificant relation with the stock returns. Hence the associations and explanatory power are not exactly robust, because both RMW and CMA are redundant in our test models, as presented in Table 5.

Table 4

Cross sectional regressions across all securities, industry types & ownership categories (Fama & Macbeth, 1973)

Security types	ALPHA	MKT	SMB	HML	PROFIT	INV.ST	R^2	F-Stat.	N
All Equity	0.0196 (*0.02*)	0.0324 (*0.011*)	0.0118 (*0.031*)	0.01959 (*0.043*)	0.0235 (*0.145*)	0.0127 (*0.283*)	0.167	13.45	360
Transportation & Logistics	0.0256 (*0.05*)	0.0232 (*0.031*)	0.079 (*0.034*)	0.148 (*0.078*)	0.0247 (*0.212*)	0.323 (*0.163*)	0.145	16.56	28
Consumer product	0.0445 (*0.024*)	0.0127 (*0.0146*)	0.147 (*0.0213*)	0.207 (*0.055*)	0.006 (*0.092*)	0.728 (*0.178*)	0.161	9.25	48
IT Sector	0.0270 (*0.04*)	0.0218 (*0.00*)	0.090 (*0.043*)	0.147 (*0.032*)	0.0256 (*0.087*)	0.345 (*0.213*)	0.098	14.78	32
Plantation & Agro sector	0.026 (*0.013*)	0.0233 (*0.0345*)	0.080 (*0.0435*)	0.149 (*0.081*)	0.0221 (*0.091*)	0.386 (*0.285*)	0.084	15.25	26
Fuel & Power	0.031 (*0.00*)	0.0195 (*0.012*)	0.087 (*0.021*)	0.132 (*0.0214*)	0.0145 (*0.085*)	0.347 (*0.00*)	0.138	12.24	34
Industrial product	0.0196 (*0.02*)	0.0324 (*0.011*)	0.118 (*0.038*)	0.1959 (*0.043*)	0.0235 (*0.125*)	0.327 (*0.283*)	0.151	26.56	45
Trade-service	0.0256 (*0.05*)	0.0232 (*0.031*)	0.079 (*0.034*)	0.148 (*0.078*)	0.0247 (*0.212*)	0.547 (*0.184*)	0.948	13.25	55
Pharmaceutical	0.236 (*0.087*)	0.068 (*0.0245*)	0.0324 (*0.078*)	0.149 (*0.081*)	0.0221 (*0.126*)	0.359 (*0.267*)	0.075	18.78	30
Govt. Owned Firms	0.0445 (*0.024*)	0.0127 (*0.004*)	0.147 (*0.0213*)	0.207 (*0.055*)	0.006 (*0.092*)	0.728 (*0.178*)	0.138	15.25	35
Non-Govt. Owned Firms	0.0196 (*0.0324*)	0.0324 (*0.011*)	0.187 (*0.031*)	0.1959 (*0.043*)	0.0235 (*0.125*)	0.327 (*0.283*)	0.149	11.24	27

This table provides significance levels of average security risk premia of cross sectional coefficients for FF5 associated with the security investment. We present *p-values* in the parentheses using monthly data. Further, we check robust *p-values* for all cross-sectional regressions and find consistent results.

Source: own study.

Finally, the model titled "ALL" includes the Momentum Factor as part of the FF5 model; however, we examine that Momentum Factor becomes statistically insignificant. Interestingly, out of six factors, the risk factor so f market, SMB and HML are statistically significant in DSE. Hence, we cannot argue that the six-factors function like that of the FF5 model. Overall, based on these different model variations, we confirm that the Fama and French three factors are significant at the level of 5 percent. This shows that stock returns in the new emerging market of Bangladesh are strongly and significantly linked to the market, size, and firm value. Overall, these results demonstrate that the three factors asset pricing model explains stock returns in Bangladesh well the. Hence, the addition of "profitability factor" (RMW), „investment fZ ZactorVZ (CMA)", and "momentum effect" (MOM) insignificantly improve model performance. Only the explanatory power of the FF5 model becomes marginally higher than traditional asset pricing models if we include the additional risk factors for the DSE. So, similarily to the initial attempt, the finding sheds new light on fair pricing of the equity instrument in Bangladesh. Finally, with the rechecked three common risk factors of DSE, the investors can estimate equity fair value, and thereby take an optimal financial and investment decision.

Based on corporate finance literature, we find that the industry practitioners, financial analysts and academic researchers are still unaware of whether or not the Fama and French five factors asset pricing model functions well in an emerging market, particularly in Bangladesh. Based on the findings of time series and cross sectional results, we propose that the security return of Dhaka stock exchange is determined by its own underlying risk factors that capture the unique features of the corresponding security, such as (a) market index, (b) firm size, (c) firm value. This academic novelty topped the earlier studies on the asset pricing model, because we document that Fama and French three factors provide better results than that of the five factors model for security pricing in DSE. We assume that the Fama and French five factors pricing model might work well for developed countries, particularly the USA and Europe, among others. In this respect, we can identify three risk factors that will help us in the security pricing of DSE;, other risk factors could also exist. The possible reason is that the average value of both time series and cross-sectional regression intercepts are statistically significant. This might be an important further research avenue and to future directions of studies:

Table 5

Robust Check Across Different Models

VARIABLES	CAPM (a)	FF3 (b)	CARHART (c)	FF5 (d)	ALL FACTORS (e)
i) MKT	1.35***	0.945**	0.879**	0.8156**	0.8011**
	(0.002)	(0.0132)	(0.0212)	(0.0321)	(0.0389)
ii) SMB		0.784**	0.5411**	0.619**	0.6234**
		(0.023)	(0.032)	(0.0389)	(0.0467)
iii) HML		0.182*	0.231*	0.215*	0.2735*
		(0.056)	(0.066)	(0.069)	(0.07145)
iv) RMW				0.1854	0.1903
				(0.2109)	(0.2309)
v) CMA				0.1514	0.1956
				(0.3130)	(0.0467)
vi) MOM			0.124		0.135
			(0.124)		(0.234)
Alpha	0.0116***	0.0029**	0.0024**	0.0037**	0.0033**
	(0.0012)	(0.031)	(0.039)	(0.0456)	(0.0489)
R-squared	0.2786	0.3485	0.3489	0.3601	0.3645

Source: own study.

5. Conclusion

In finance literature, the central theme of asset pricing theory is to identify the inherent common risk factors of security pricing. Overall, we find that the three-factors (market index, firm size and firm value) function well relative to all other models when explaining stock return performances of DSE, Bangladesh. However, we document that the model performance insignificantly improves due to the inclusion of investment strategy and firm profitability. It implies that both factors present an incremental but insignificant level of explanatory power for stock return in Bangladesh. The results that average return and *t*-statistic on profitability & investment circumstances are marginal for Bangladesh stocks also initially supports this important conclusion. Moreover, the size and value effect along with market risk premium are stable and also statistically significant across all settings. The study moreover reveals the invalidity of the momentum factor as part of asset pricing theory for security valuation in Bangladesh.

The theoretical discussion and empirical analysis of this study has delved into main issues associated with the relationship between conventional asset pricing factors and equity returns in DSE.

In summary, the work follows Fama and French (2015) to consider underlying common risk factor returns, due to the special features and market efficiency of DSE. Hence, how the structure of asset pricing underlying factors influence stock returns or whether other crucial pricing factors exist in DSE would further be interesting topics. Finally, having rechecked and identified three significant common risk factors, the market analysts can use them for equity assessment, buy-sell recommendations and, finally, take the optimal investment decision. However, the proposed model requires more investigation and analysis if it fits with the expectation of all the stakeholders in the market. Therefore, the future can proceed further empirical study to confirm the reliability and validity of the three factors (market, size and value) model instead of five factors model for appropriate security pricing in an emerging economy.

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