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Cross-Section of Expected Stock Returns: An Application of Fama-French Five Factor Model in Nepal

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Abstract

This study aimed to analyze the efficiency of Fama-French five factor model to explain cross-section stock returns in Nepalese stock market. The study adopted descriptive and analytical research design. Out of 228 firms listed in NEPSE, following judgmental sampling design, 65 firms were selected which met the sampling criteria. Panel data was collected from secondary source for the period of July 16, 2016 to July 16, 2022. Sampling frame, daily stock prices and dividends were obtained from official website of Nepal Stock Exchange (NEPSE). Firm-specific accounting data was obtained from annual reports of sample firms. 28 days weighted average Treasury bill rates were used as a proxy for risk free rate which was obtained from Economic bulletin of Nepal Rastra Bank. Three types of portfolios were constructed namely 25 Size-BM portfolios, 25 Size-ROE portfolios and 25 Size-Investment portfolios. Factor returns were created by using 2 × 3 and 2 × 2 × 2 × 2 sorting. Regression result revealed that the Fama-French five factor model is capable to capture the variation in cross-section stock returns in Nepal. Among five factors, the market risk premium found to be the most prominent factor affecting stock returns.

Keywords: cross-section of expected stock returns, Fama-French five factor model, asset pricing model

Introduction

In the finance literature, stock returns have long been a focal point of study. Markowitz (1952) developed the theory of Modern Portfolioy, which was the base for several concepts and theories developed in the risk and return. The heart of Modern Portfolio theory is mean-variance analysis. It tries to maintain trade-off between the expected return and variance of returns on a portfolio. Based upon the Modern Portfolio theory, Sharpe (1964), Lintner (1965), and Black (1972) evoluted the Capital Asset Pricing Model (CAPM). It suggests that the there is linear relationship between equilibrium return of any stock and market beta.

However, Ross (1976) found that the variation in stock returns can be explained by market beta only upto the extent of 40%. Criticism of CAPM by Ross resulted to the

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origination of the Arbitrage Pricing Theory (APT). APT argues that stock returns are explained by multi-factor model as opposed to the single factor model advocated by CAPM. With the innovation of APT, there is growing consent among researchers that only market beta is insufficient to explain the variation in average stock returns adequately. The value effect of Stattman (1980), size effect of Banz (1981), the earnings–price (E/P) effect of Basu (1983), and the leverage effect of Bhandari (1988) confronted the CAPM.

Similarly, Fama and French (1992) explored that the cross-sectional volatility in stock returns is explained by market risk premium, firm size and book-to-market equity. Furthermore, Fama and French (1993) created a three-factor model that addressed for anomalies revealed in the CAPM. Similarly, the four-factor model was recognized by Carhart (1997). It augmented one more factor to the Fama-French three factor model which is known as momentum factor. It argues that stocks which have performed well in the past, would continue to perform well in the future and similarly, stocks which have performed bad in the past, would continue to perform bad in the future.

To overcome the deficiencies of Fama-French three factor model, Fama and French (2015) developed five-factor asset pricing model. Fama-French five factor model is an augmented version of Fama-French three factor model which added profitability and investment factors to the original model. They argued that volatility in stock returns is explained by five factors namely market beta, firm size, book to market equity factor, profitability factor and investment factor. However, this model also explains that HML (value premium) is a redundant factor and four factor model excluding HML is equally efficient with five factor model to explain the variation in stock returns.

Fama-French five factor model has just been in literature of finance for nine years which is still in infant stage. An important motivation for this research work is that empirical evidences have tended to yield inconsistent findings and its relevance in emerging market such as Nepal Stock Exchange is yet to be tested. Conducting studies on Fama-French five factor model is new in Nepal and hence, exploring on this topic contributes to the literature of asset pricing model. Hence, this study attempts to fill the research gap by using data from Nepal Stock Exchange (NEPSE). Hence, this study aims to test the efficiency of Fama-French five factor model (2015) to explain variation in stock returns in emerging market such as Nepal Stock Exchange.

Review of Literature

Various studies proved that stock returns are better explained by multifactor models. For instance, the value effect of Stattman (1980), the size effect of Banz (1981), the earning–price (E/P) effect of Basu (1983), the leverage effect of Rosenberg et al. (1985), Bhandari (1988) and Chan et al. (1991) challenged the CAPM. Similarly, Fama and French (1992, 1993, 2015) also challenged the CAPM.

In against of the CAPM, it is widely accepted by many researchers that stock returns are not only affected by market beta but it has additional predictors too. For instance, Ball (1978) argued that earning price (E/P) can explain variation in stock returns. Stattman (1980) found that average returns in the US stock markets are positively related to the firm's book value of common equity to its market value ratio. Banz (1981) discovered that there is significant negative relationship between firm size and stock returns. Similarly, Basu (1983) discovered that the earning price (E/P) has significant power in explaining stocks returns in America. Furthermore, Bhandari (1988) found that stock returns are also explained by firm's leverage ratio. Similarly, Ross's APT model (1976), Fama and French's three factor model (1993), Carhart's four-factor (1997) and Fama-French five factor model (2015) have contributed on the development of asset pricing model.

Several empirical evidences accepted the supremacy of Fama-French five factor model. For instance, Singh and Yadav (2015) found that the five-factor model performs better than the competing models in portfolios formed on investment. However, it was also suggested that the four-factor model (excluding investment premium) is more efficient to explain the variation in stock returns. Similarly, Chiah et al. (2016) found that the five-factor model is able to explain more asset pricing anomalies than its competing asset pricing models. Guo et al. (2017) found that the five-factor model proved itself to be the superior asset pricing model among its competing asset pricing model in Chinese stock market.

However, some empirical evidences rejected the superiority of Fama-French five factor model. Jiao and Lilti (2017) concluded that profitability and investment premium do not have much additional explanatory power and Fama-French five factor model does not have significant improvement in explaining average excess stock returns in Chinese stock market. Foye (2018) found that the profitability or investment premium cannot be clearly distinguished in the Asian stock market and the five-factor model fails to provide an improved explanation of excess stock returns in the Asian market. Ekaputra and Sutrisno (2020) highlighted that Fama French five factor model does not perform better than Fama French three factor model in explaining variation in cross-section excess

portfolio returns. Kostin et al. (2022) rejected the general notion of adacemicians that the use of multi-factor asset-pricing models automatically results meaningful data. The study suggested to reconsider the perception that the addition of more firm-specific factors to asset pricing models does not necessarily provide better results.

In Nepal, the relevance of Fama-French five factor model has not yet been tested so far as per the researcher's best knowledge. However, few attempts have been made to examine the performance of Fama-French three factor model (Karki & Ghimire, 2016; Panta et al., 2016). These studies suggested the superiority of Fama-French three factor model over single factor model.

Methods

Descriptive and analytical research design were used in this study. Portfolio analysis was conducted to examine the pattern in average excess portfolio returns according to size, book to market equity ratio, profitability and investment factors based on three types of portfolios namely 25 Size-BM portfolios, 25 Size-ROE portfolios and 25 Size-Investment portfolios. Mean and standard deviation were used to explain the descriptions of five factors through summary statistics. This study also used regression analysis to investigate the factors impacting cross-section returns.

Table 1

Sampling Criteria

S No	Sampling Criteria
1	Suspended and delisted firms by Nepal Stock Exchange are excluded from sample selection due to lack of data of these firms.
2	NEPSE has created the highest peak at the index of 1881.88 in July 27, 2016. Nepalese capital market has plunged to the bottom of bearish trend at 1102.02 in March 03, 2019 and again reached to the height of 3132.87 on August 15, 2021. NEPSE has spent a complete cycle of bull and bear during that period. Hence, the study has taken study period from July 16, 2016 to July 16, 2022. Firms should be listed in NEPSE before July 16, 2016 to be selected as sample firm.
3	Crisis-ridden banks and financial institutions declared by Nepal Rastra Bank is excluded from sample due to irregular trading in NEPSE.
4	Firms should have published audited annual reports completely and duly to be selected as sample firms.

A total of 228 active companies were listed in official website of Nepal Stock Exchange as on 5 July, 2023. Among them, following judgmental sampling design, 65 companies (20 commercial banks, 8 development banks, 7 finance companies, 11 micro-finance companies, 4 life insurance companies, 7 non-life insurance companies, 4 hydropower companies, 1 manufacturing and processing companies, 1 hotel and tourism company, 1 investment company and 1 company from other sector) were selected which met the sampling criteria (Table 1).

Panel data for the study period from July 16, 2016 to July 16, 2022 is collected from secondary source. Sampling frame, daily stock prices and dividends were obtained from official website of Nepal Stock Exchange (NEPSE). Firm-specific accounting data were obtained from annual reports of listed companies. Risk free rate was obtained from 28 days weighted average Treasury bill rates published in Economic bulletin of Nepal Rastra Bank.

Factor sorting

Factor sorting was conducted for formation of building blocks. Building blocks were then used for formation of factors such size premium (SMB), value premium (HML), profitability premium (RMW) and investment premium (CMA). Factor returns were created by using 2 × 3 and 2 × 2 × 2 × 2 sorting.

2 × 3 Sorting. Building blocks were created using Size-BM, Size-ROE and Size-Investment sorting under 2 × 3 Sorting. In 2 × 3 Size-BM sorting, sample firms were first arranged in ascending order by size at year *t-1*. Then, 65 sample firms were categorized into two groups separated by median value of market equity (firm size). One firm which lied on median value was eliminated and rest 64 firms were divided into two groups- small sized (S) and big sized (B) each including 32 firms. 32 firms included in each size group were further arranged in ascending order according to book to market equity (BM) ratio at year *t-1*. Each size group was further subdivided into three BM groups using 30^{th} and 70^{th} percentiles of BM ratio – low B/M group (L) including 10 firms, neutral group (N) including 12 firms and high B/M group (H) including 10 firms. Hence, six building blocks were created in this process, i.e., SH, SN, SL, BH, BN and BL. The procedures of 2 × 3 Size-ROE sorting and 2 × 3 Size-Investment sorting were same with 2 × 3 Size-BM sorting except the case that ROE and Investment were used in place of BM ratio. Six building blocks were created in 2 × 3 Size-ROE sorting, i.e., SR, SN, SW, BR, BN and BW. Similarly, six building blocks were created in 2 × 3 Size-Investment sorting, i.e., SC, SN, SA, BC, BN and BA. (Table 2).

2 × 2 × 2 × 2 Sorting. Market equity was calculated at the end of the year *t-1* and then arranged in ascending order. Then, it was divided into two groups based on median of market equity as cut off point. Whole sample of firms was divided into two categories, i.e., small (S) and big (B), each having 32 small firms and large firms. Size sorted portfolios were further sorted according to book to market value of equity. Each size groups were arranged in ascending order and splited into two new groups on basis of median value of book to market value of equity as cut off point. Four value sorted groups were formed namely SL, SH, BL and BH respectively. Each value sorted groups were arranged in ascending order and further splited into two new groups on the basis of median value of ROE as cut off point. Eight profitability sorted portfolios were formed namely SLW, SLR, SHW, SHR, BLW, BLR, BHW and BHR respectivley. Finally, profitability sorted portfolios were again arranged in ascending order according to investment in assets and each group was further splited into two new groups on the basis of investment. Hence, 16 portfolios were formed namely SHRC, SHRA, SHWC, SHWA, SLRC, SLRA, SLWC, SLWA, BHRC, BHRA, BHWC, BHWA, BLRC, BLRA, BLWC and BLWA respectively (Table 2).

Table 2

Factor Returns Constructed From 2 × 2, 2 × 3 and 2 × 2 × 2 × 2 Sorting

Sort	Breakpoint	Factors and their components
2 × 3 sorts Size and B/M, Size and ROE, Size and Inv.	Size: Median B/M, ROE and Inv.: 30th and 70th percentiles	$SMB_{B/M}$ = (SH+SN+SL)/3 – (BH+BN+BL)/3 SMB_{ROE} = (SR+SN+SW)/3 – (BR+BN+BW)/3 SMB_{Inv} = (SC+SN+SA)/3 – (BC+BN+BA)/3 SMB = ($SMB_{B/M}$ + SMB_{ROE} + SMB_{Inv})/3 HML = (SH+BH)/2 – (SL+BL)/2 RMW = (SR+BR)/2 – (SW+BW)/2 CMA = (SC+BC)/2 – (SA+BA)/2
2 × 2 × 2 × 2 Sorts on Size, B/M, ROE and Inv.	Median	SMB = (SHRC+SHRA+SHWC+SHWA+ LRC+SLRA+SLWC+SLWA)/8 – (BHRC+BHRA+BHWC+BHWA+LRC+BLRA+BLWC+BLWA)/8 HML = (SHRC+SHRA+SHWC+SHWA+BHRC+BHRA+BHWC+BHWA)/8– (SLRC+SLRA+SLWC+SLWA+BLRC+BLRA+BLWC+BLWA)8 RMW = (SHRC+SHRA+SLRC+SLRA+BHRC+BHRA+BLRC+BLRA)/8 – (SHWC+SHWA+SLWC+SLWA+BHWC+BHWA+BLWC+BLWA)/8 CMA = (SHRC+SHWC+SLRC+SLWC+BHRC+BHWC+BLRC+BLWC)/8 – (SHRA+SHWA+SLRA+SLWA+BHRA+BHWA+BLRA+BLWA)/8

Source. Fama and French (2015)

Research Model, Definition of Variables and Hypothesis

Research Model. This study used the empirical model prescribed by Fama and French (2015) which is explained in model 1.

$$E(Rp) = \alpha + b_i MKT + s_i SMB + h_i HML + r_i RMW + c_i CMA + e_i \ldots\ldots\ldots\ldots (1)$$

Where,

$E(Rp)$ = Portfolio excess returns

α = Intercept

b_i, s_i, h_i, r_i and c_i = Coefficients to be estimated

MKT = Market Risk Premium

SMB = Size Premium (Small minus Big)

HML = Value Premium (High minus Low)

RMW = Profitability Factor (Robust minus Weak)

CMA = Investment Factor (Conservative minus Weak)

Based on the model, market risk premium, size premium, value premium, profitability factor and investment factor are the five factors which are supposed to explain the variation in cross-section portfolio excess returns. Regression equations are run by the use of SPSS version 26 to examine the significant factors to explain the variation in average portfolio excess returns.

Definition of Variables. Operational definition of study variables are:

Portfolio Excess Returns. Portfolio excess return is used as dependent variable in this study. Monthly returns of each stock were calculated by using difference of ending stock price at month *t* and ending price at month *t-1* plus dividend at the end of month *t* divided by ending price at month *t-1*.

Monthly stock excess returns was calculated by difference between monthly returns of each stock and monthly returns of 28 days Treasury bill rate. Then, the monthly excess stock returns were used to create 25 value-weighted (VW) portfolios in each Size-BM, Size-ROE and Size-Investment sorting. Market equity at the end of year *t-1* was used for value weight of each portfolios. In this process, 75 portfolios were created using different combination of Size-BM-ROE-Investment sorting. Portfolio excess returns are explained with the help of equation 2, 3 and 4.

$$\text{Stock return } (r_s) = \frac{(P_t - P_{t-1}) + D_t}{P_{t-1}} \ldots\ldots\ldots\ldots (2)$$

$$\text{Stock Excess Return} = r_s - r_f \quad \ldots\ldots (3)$$

$$\text{Portfolio Excess Return } (r_p) = \sum_{i=1}^{n} w_i . r_i \quad \ldots\ldots (4)$$

Where,

P_t = Price of stock at the end of month *t*
P_{t-1} = Price of stock at the end of month *t-1*
D_t = Dividend of stock at the end of month *t*
r_f = Risk-free rate (Monthly return of 28 days Treasury bill)
w_i =Value weight of stock *i* in the portfolio
r_i =Monthly excess return of stock *i* in the portfolio

Market Risk Premium. Market risk premium is the first independent variable which is assumed to explain the variation in cross-section portfolio excess returns. Market risk premium is defined as difference between monthly market return and risk-free return. Market market return was obtained from NEPSE index at the end of month *t* divided by NEPSE index at the end of month *t-1* minus 1. Similarly, risk-free return is defined as monthly return of 28 days Treasury bill.

$$R_{mt} = \frac{NEPSE_t}{NEPSE_{t-1}} - 1 \quad \ldots\ldots (5)$$

$$MKT = \text{Market Risk Premium} = R_{mt} - R_{ft} \quad \ldots\ldots (6)$$

Where,

$NEPSE_t$ = NEPSE Index at month *t*
$NEPSE_{t-1}$ = NEPSE Index at month *t-1*
R_{mt} = Market rate of return at time t
R_{ft} = Risk free rate of return at time t

Size Premium. Size premium is used as one of the predictors of stock returns. Market equity (also known as market capitalization) is used for calculation of size premium. It is calculated as the product of number of shares outstanding and closing market prices at year *t-1*. Size premium is defined as returns of portfolio of small firms minus returns of portfolio of big firms. SMB is used as a proxy for size premium.

Value Premium. Value premium is another predictor of stock returns. Book value of equity was obtained by including paid up equity and preference share, share premium, reserve and surplus, other reserve and fund related to shareholders. Book to market equity ratio is calculated as the ratio between book value of equity and market value of

equity of the firm. HML is used as a proxy for value premium which is defined as returns of portfolio of firms with high book to market equity ratio minus returns of portfolio of firms with low book to market equity ratio.

Profitability Factor. Profitability factor is another predictor of portfolio excess returns. ROE is used for profitability sorting. ROE is defined as net profit after tax divided by book value of equity. RMW is used as a proxy for profitability factor. RMW is defined as returns of portfolio of firms with high ROE minus that of with low ROE.

Investment Factor. Investment factor is the last predictor of portfolio excess returns. It is defined as growth rate in total assets and algebraically expressed as the ratio of total assets in year *t*-1 divided by total assets in year *t-2* minus 1 (Fama & French, 2015). Investment factor is defined as returns of portfolio of firms with conservative investment group minus returns of portfolio of firms with aggressive profitability group. CMA is used as a proxy for investment factor.

Technically, proxies for size, value, profitability and investment premium such as SMB, HML, RMW and CMA were constructed by using the different combinations of building blocks through 2×3 and 2×2×2×2 versions of portfolio sorting.

Hypotheses. This study established five null hypotheses for each factors to be tested using Ordinary Least Square (OLS) regression in order to explore whether or not these five factors explain the portfolio excess returns significantly.

H_{01}: There is no significant impact of market risk premium on variation in portfolio excess returns.
H_{02}: Size premium does not explain variation in portfolio excess returns.
H_{03}: Value premium is redundant to explain variation in portfolio excess returns.
H_{04}: Profitability pattern does not add to the explanation on variation in portfolio excess returns.
H_{05}: Investment factor does not have influence on variation in portfolio excess returns.

Results

Portfolio Analysis

This study is intended to examine whether five factor model explain average monthly excess returns on portfolios which is formed on size, B/M, profitability and investment. For this purpose, the first step is to examine the effect of size, B/M, profitability and investment in average returns of portfolios. The study attempts to examine the pattern in average excess portfolio returns according to size, book to market equity ratio,

profitability and investment factors based on three types of portfolios namely 25 Size-BM portfolios, 25 Size-ROE portfolios and 25 Size-Investment portfolios.

Panel A of Table 3 shows average monthly excess returns for value-weighted independent sorts of stocks into five Size groups and 5 B/M groups which is labelled as 25 Size-BM groups. In each B/M column, average excess portfolio returns fall from small size portfolios to big size portfolios. Speaking precisely, low sized stocks outperform the big sized stocks. The size effect is more intense and monotonic in fourth column where average excess returns fall from 2.69% in smallest sized portfolios to -1.68% in biggest size portfolios. Similarly, the value effect is clearly detected in first row where average returns increase from 0.53% in lowest B/M portfolios (growth stocks) to 2.58% to largest B/M portfolio (value stocks). However, no obvious value effect can be seen in rest rows. Hence, it is concluded that value effect is intense only in small sized portfolios.

Panel B of Table 3 shows average monthly excess returns for value-weighted independent sorts of stocks into five Size groups and 5 ROE groups which is labelled as 25 Size-ROE groups. In each ROE column, average excess returns typically fall from small size portfolios to big size portfolios. The size effect is more intense and monotonic in third column where average excess returns fall from -0.47% in smallest sized portfolios to –1.38 % in biggest size portfolios. However, there is no obvious profitability effect in each size row. Average monthly returns fluctuate from low ROE portfolios to high ROE portfolios. Hence, it is examined that profitability effect has no clear direction while size effect is still pertinent in Size-ROE portfolios.

Panel C of Table 3 shows average monthly excess returns for value-weighted independent sorts of stocks into five size groups and five Investment groups which is labelled as 25 size-investment groups. In each column, average excess returns typically fall from small size portfolios to big size portfolios. The size effect is monotonic in the third column where average excess returns fall from 0.69% in smallest portfolios to –1.61 % in biggest portfolios. In each Investment column, small size portfolios simultaneously outperform large size portfolios. However, average excess returns increase from low investment group to high Investment group in the first, third and fourth row. Though weaker relationship, average excess returns decrease from low Investment group to high Investment group in the second and last row. Hence, it is concluded that size effect is strong in Size-Investment portfolios while investment effect has mixed results.

Table 3

Average Monthly Percentage Excess Returns for formed on 25 Size-B/M, 25 Size-ROE and 25 Size-Investment Portfolios

	Low	2	3	4	High
Panel A: Size/BM					
Small	0.53	0.81	0.97	2.69	2.58
2	0.25	-0.36	-0.61	0.22	0.77
3	2.27	-0.82	-0.1	0.21	0.48
4	-0.42	-0.53	-1.16	-0.95	-0.02
Large	-1.86	-1.37	-1.29	-1.68	0.24
Panel B: Size/ROE					
Small	-0.68	1.13	-0.47	-0.67	0.22
2	-0.42	-0.15	-0.59	-1.29	-0.55
3	-0.08	-1.34	-0.89	-1.19	-0.42
4	-0.93	-0.33	-1.37	-1.06	-1.03
Large	-0.95	-0.93	-1.38	-1.26	-1.94
Panel C: Size/Investment					
Small	1.32	1.44	0.69	1.81	1.62
2	0.65	-0.17	-0.32	0.18	-0.14
3	-0.77	-0.11	-0.07	-0.03	-0.37
4	-0.84	0.69	-0.76	-0.62	-0.19
Large	-0.79	-1.02	-1.61	-1.03	-1.44

Source: SPSS Output

Summary Statistics of Factor Returns

Four factors SMB, HML, RMW and CMA are constructed as a proxy for independent variables such as size premium, value premium, profitability premium and investment premium. These four factors are constructed through 2 × 3 and 2 × 2 × 2 × 2 sorting. However, market risk premium is constructed as difference between market return and risk-free return and is same for all kinds of portfolios and sorting.

Table 4 shows the mean and standard deviation of factor returns under 2 × 3 and 2 × 2 × 2 × 2 versions of sorting. Average market risk premium and its standard deviation are 0.3% and 3.42% respectively. These values are same for both versions of factors sorting because market risk premium is common for all portfolios.

Average SMB factors range from 1.42% to 1.47% per month for two versions of factors. Similarly, standard deviations of two versions of SMB are similar and ranges between

2% to 2.17%. Similar means and standard deviation of SMB is obvious because both versions of SMB use all stocks.

Table 4

Average and Standard Deviation of Monthly Factor Returns in Percentage

	Rm-Rf	SMB	HML	RMW	CMA
Panel A: 2 × 3 Factors					
Mean	0.3	1.42	1.55	-0.56	-0.17
Standard Deviation	3.42	2	2.04	1.02	1.26
Panel B: 2 × 2 × 2 × 2 Factors					
Mean	0.3	1.47	1.24	-0.14	0.18
Standard Deviation	3.42	2.17	1.6	0.55	0.89

Source: SPSS Output

Average HML returns ranges from 1.24% to 1.55% and standard deviation ranges from 1.6% to 2.04% in both versions of factors. Both average returns and standard deviation is the highest in 2 × 3 sorting. It is obvious because 2 × 3 sorting leaves middle 40% stocks and hence, does not include all stocks. 2 × 3 sorting focus more on the extreme values of the variables and produces larger average returns. Hence, it makes poor diversification in constructing portfolios.

Average RMW is negative in all versions of factor sorting which is quite surprising. It argues that weak profitable stocks generate more average excess returns than robust profitable stock returns. It shows that stock returns are more influenced by insider trading, herd mentality rather than fundamental news. Standard deviation is the highest in 2 × 3 sorting which again proves that it makes poor diversification compared to 2 × 2 × 2 × 2 sorting. Similarly, average CMA is negative in 2 × 3 sorting which indicates aggressive stocks makes more return than conservative stocks. However, positive CMA in 2 × 2 × 2 × 2 sorting is positive which indicates the dominance of conservative stocks.

Regression Results

This section explains 75 regression results of portfolio excess return on factor returns in 25 Size-BM portfolios, 25 Size-ROE portfolios and 25 Size-Investment portfolios. Result from 2 × 3 and 2 × 2 × 2 × 2 sorting are similar. Hence, the results are shown in only 2 × 3 sorting similar to the procedure of Fama and French (2015).

Table 5 shows the results of OLS regression of portfolios excess return on five factor returns in 25 Size-BM portfolios. Portfolios are arranged in ascending order from P1 to P25 in order of size. Hence, portfolios from P1 to P12 are termed as small sized

portfolios and portfolios from P13 to P25 are termed as big sized portfolios. The regression result shows that five factor model is significant at 1% significance level (p <.001) in all portfolios except in P25 where it is significant at 5% level (p <.05). This implies that five factor model is efficient to explain majority of variation in cross section portfolio returns.

Table 5

Regression Results on 25 VW Size-BM Portfolios

Port.	Intercept	B	s_i	h_i	r_i	c_i	R^2	F test
P1	-2.210	0.35*	1.76**	-0.160	-0.120	-0.260	0.750	39.260
P2	-1.450	0.49*	1.02**	-0.180	-0.96**	-1.41**	0.570	17.150
P3	-2.060	0.370	1.62**	-0.113	-0.94**	-1.38**	0.690	29.790
P4	-0.230	0.57*	1.30**	-0.240	- 1.16**	-2.33**	0.670	25.610
P5	0.030	0.360	1.54**	-0.280	- 1.04**	-0.96*	0.540	15.120
P6	-0.450	0.39*	0.99**	-0.306	0.290	0.93**	0.530	14.150
P7	-1.820	0.59**	1.37**	-0.42**	0.390	0.62*	0.690	28.350
P8	-2.260	0.56**	1.27**	-0.49**	0.000	0.550	0.590	18.220
P9	-1.131	0.56**	0.88**	-0.200	0.030	0.200	0.570	16.770
P10	-1.015	0.42**	0.72**	-0.070	-0.757**	-1.34**	0.690	29.170
P11	-2.370	0.56**	0.84**	-0.210	0.312	0.416	0.490	12.690
P12	-1.980	0.242	0.84**	-0.35*	0.52*	0.765**	0.590	18.350
P13	-0.969	0.663**	0.55*	-0.053	0.565*	-0.070	0.560	16.480
P14	-1.519	0.455**	0.516*	0.049	-0.59*	-1.15**	0.540	15.080
P15	-0.880	0.411**	0.81**	-0.090	-0.300	-0.261	0.580	17.930
P16	-1.390	0.53**	0.72**	-0.23*	0.140	0.300	0.530	14.400
P17	-0.630	0.64**	0.244	0.119	0.090	-0.49*	0.370	7.670
P18	-1.640	0.69**	0.030	0.040	-0.060	-0.45*	0.470	11.230
P19	-1.285	0.58**	0.009	0.030	-0.070	-0.41*	0.420	9.300
P20	-0.248	0.52**	0.060	-0.070	-0.210	-0.35*	0.480	11.700
P21	-2.36*	0.39*	0.49*	-0.177	0.029	0.294	0.310	5.770
P22	-1.688	0.51**	0.290	-0.040	0.232	0.316	0.380	7.940
P23	-1.596	0.53**	0.080	0.120	0.310	0.100	0.370	7.390
P24	-2.516**	0.36**	0.49*	0.160	0.280	0.310	0.380	7.710
P25	0.461	0.34**	-0.050	-0.070	-0.090	0.290	0.160	2.440

*$p < 0.05$. **$p < 0.01$.

Speaking individually on each factors, it is revealed that market risk premium is significant in almost all portfolios (p<.05). Size premium is significant in small size portfolios from P1 to P16 (p<.05). Profitability factor is significant mostly in small sized portfolios while investment factors are significant in almost 50 percent portfolios (p<.05). However, value premium, HML is insignificant (p>.05) in most of the cases with few exceptions. It reinforces the findings of Fama and French (2015) that HML is the

redundant factor and elimination of HML factor helps improvement of efficiency of asset pricing model. Negative sign of HML, RMW and CMA is quite surprising because it indicates the dominance of low valued, less profitable and aggressive stocks over high valued, more profitable and conservative stocks. R^2 is upto 75% in small sized portfolios while it plunges upto 16% in large sized portfolios. It indicates that five factor model better explain the variation in cross section of small sized portfolios than large sized portfolios. Similarly, Table 6 shows the results of OLS regression of portfolios excess returns on five factor returns in 25 Size-ROE portfolios.

Table 6

Regression Results on 25 VW Size-ROE Portfolios

Port.	Intercept	B	s_i	h_i	r_i	c_i	R^2	F test
P1	-2.026	0.337*	1.752**	-0.162	-0.123	-0.280	0.750	39.32
P2	-1.267	0.490*	1.012**	-0.187	-0.970**	-1.429**	0.570	17.27
P3	-1.881	0.350	1.610**	-0.121	-0.952**	-1.414**	0.710	30.68
P4	-0.042	0.540*	1.294**	-0.260	-1.179**	-2.383**	0.670	26.65
P5	-0.205	0.350	1.530**	-0.281	-1.047**	-0.976*	0.540	15.19
P6	-0.257	0.340*	0.990**	-0.340*	0.260	0.800**	0.490	12.1
P7	-1.625	0.519**	1.370**	-0.460**	0.330	0.450	0.660	24.76
P8	-2.079	0.554**	1.265**	-0.489**	0.000	0.548	0.590	18.22
P9	-0.948	0.542**	0.870**	-0.210	0.018	-0.247	0.570	16.59
P10	-0.840	0.429**	0.714**	-0.066	-0.748**	-1.323**	0.690	28.01
P11	-2.193*	0.551**	0.836**	-0.208	0.311	0.409	0.490	12.64
P12	-1.792	0.194	1.417**	-0.375**	0.486*	0.655*	0.570	16.89
P13	-0.782	0.630**	0.545*	-0.070	0.541*	-0.149	0.550	15.53
P14	-1.339	0.445**	0.510*	0.044	-0.596	-1.169*	0.540	15.28
P15	-0.689	0.375**	0.810**	-0.115	-0.329	-0.343	0.690	18.33
P16	-1.204	0.501**	0.714**	-0.246*	0.125	0.242	0.520	13.62
P17	-0.450	0.625**	-0.251	0.113	-0.088	-0.508*	0.370	7.55
P18	-1.461	0.680**	0.022	0.038	-0.058	-0.467*	0.460	11.07
P19	-1.103	0.560**	0.002	0.019	-0.075	-0.440*	0.420	9.19
P20	-0.066	0.497**	0.051	-0.077	-0.221	-0.394*	0.480	11.72
P21	-2.183*	0.388*	0.488*	-0.175	0.033	0.300	0.310	5.77
P22	-1.504	0.483**	0.288	-0.055	0.214	0.258	0.360	7.25
P23	-1.410	0.502**	0.073	0.101	0.288	0.028	0.340	6.49
P24	-2.327*	0.319*	0.495*	0.139	0.251	0.220	0.340	6.61
P25	-0.645	0.315*	-0.055	-0.081	-0.102	0.235	0.140	2.089

*$p < 0.05$. **$p < 0.01$.

In Table 6, portfolios are arranged in ascending order from P1 to P25 in order of size. Hence, portfolios from P1 to P12 are termed as small sized portfolios and portfolios from P13 to P25 are termed as big sized portfolios. The regression result shows that five factor

model is significant at 1% significance level (p<.001) in all portfolios except portfolio P25. Speaking individually on each factors, it is revealed that market risk premium are significant in most of the portfolios (p<.05). Size premium is significant in small size portfolios in most of the cases (p<.05). Value and profitability factors are significant only in few portfolios (p<.05) while investment factors are significant in both small and big sized portfolios. It reveals that market risk premium, size premium and investment are significant factors explaining the variation in stock returns while value and profitability factors fail to explain in most of the cases.

Table 7

Regression Results on 25 VW Size-Investment Portfolios

Port.	Intercept	B	s_i	h_i	r_i	c_i	R^2	F test
P1	-1.155	0.448*	1.15**	-0.180	-0.647*	-1.31***	0.670	26.010
P2	-1.515	0.43*	1.79**	-0.130	-0.60*	0.080	0.570	16.640
P3	-2.013	0.370	1.25**	-0.157	-1.17**	-1.46**	0.620	21.160
P4	-0.829	0.59**	1.44**	-0.39**	-1.03**	-1.34**	0.740	35.980
P5	-1.392	0.374	1.72**	-0.086	-0.464	-1.207**	0.690	28.360
P6	-0.468	0.40*	0.97**	-0.323**	-0.150	0.53*	0.540	13.000
P7	-1.588	0.622**	1.34**	-0.49**	0.190	0.360	0.640	22.840
P8	-1.954*	0.62**	1.025**	-0.150	0.206	-0.030	0.680	27.060
P9	-1.319	0.563**	1.161**	-0.173	0.190	0.490	0.580	17.290
P10	-1.89*	0.49**	0.66**	-0.33**	-0.002	-0.100	0.610	20.090
P11	-1.957*	0.443**	0.709**	-0.050	0.309	0.210	0.480	11.580
P12	-1.179	0.54**	0.72*	-0.080	0.330	0.440	0.370	7.570
P13	-1.513	0.551**	1.11**	-0.28*	0.190	0.310	0.630	21.840
P14	-1.663	0.405*	1.31**	-0.303*	0.433	-0.240	0.620	21.230
P15	-1.833*	0.56**	0.64**	-0.050	-0.240	-0.830	0.650	23.280
P16	-1.76**	0.43**	0.140	-0.020	0.160	0.070	0.400	8.690
P17	-1.128	0.443**	-0.020	0.030	-0.310	-0.330	0.240	4.140
P18	-1.182	0.724**	-0.020	0.020	0.050	-0.230	0.480	12.020
P19	-1.496*	0.67**	0.39*	-0.124	-0.240	-0.120	0.580	17.850
P20	0.911	0.70**	0.140	-0.010	0.070	-0.62*	0.460	10.840
P21	-0.351	0.431**	-0.060	-0.140	-0.080	0.453*	0.250	4.290
P22	-1.643	0.703**	0.030	0.160	0.170	0.130	0.360	7.310
P23	-2.380	0.45**	0.51*	0.070	0.360	0.48*	0.430	9.820
P24	-2.022	0.40*	0.459	0.089	0.190	0.230	0.260	4.500
P25	-1.615*	0.565**	0.150	0.000	0.330	-0.060	0.470	11.140

*$p < 0.05$. **$p < 0.01$.

On the other hand, Table 7 shows the results of OLS regression of portfolios excess returns on five factor returns in 25 Size-Investment portfolios. Portfolios are arranged in ascending order from P1 to P25 in order of size. Hence, portfolios from P1 to P12 are

termed as small sized portfolios and portfolios from P13 to P25 are termed as big sized portfolios.

The regression result shows that the five factor model is significant at 1% significance level ($p<.001$) in all portfolios. Speaking individually on each factors, it is revealed that market risk premium are significant in almost all portfolios ($p<.05$). Size premium is significant in small size portfolios from P1 to P15 ($p<.05$). Value, profitability and investment factors are significant only in few portfolios ($p<.05$). It reveals that market risk premium and size premium are significant factor explaining the variation in stock returns while value, profitability and investment factor fails to explain in most of the cases.

Discussion

The result of this study is similar to the findings of Fama and French (2015). This study found that Fama-French five factor model is efficient to explain the variation in stock returns. Similarly, this study explored that HML is redundant factor and elimination of value premium helps in improvement of asset pricing model. This finding is consistent with the result of Chiah et al. (2016), Fama and French (2015) and Guo et al. (2017).

However, some results are contrary to the findings of Fama and French (2015). Specially, negative sign of HML, RMW and CMA is quite surprising because it indicates the dominance of low valued, less profitable and aggressive stocks over high valued, more profitable and conservative stocks. Speaking elaborately, the findings of this study revealed that stocks with low B/M outperforms stock with high B/M stocks, stocks with low profitability outperforms stocks with high profitability and aggressive stocks outperform conservative stocks. It may be because Nepal Stock Exchange (NEPSE) is not as efficient stock market as in developed countries. These phenomena are usual in under-developed stock market such as NEPSE. The reasons may be herd mentality of investors, lack of investment and financial literacy among the investors, lack of big and institutional investors, lack of effective investor awareness programs and presence of malpractices in stock trading such as thin trading, pump and dump strategy, leak of sensitive information before available to general public and so on. Another reason may also be that stock market in real life does not follow the principles of traditional finance. Behavioural finance has its own place to explore the behaviour of stock market in real life. Moreover, market risk is revealed as the most prominent factors affecting stock returns in all sorts of portfolios. This finding is also similar to the CAPM of Sharpe (1964), Lintner (1965), and Black (1972).

Since, Fama-French five factor model is still in infant stage and requires more empirical works to validate its relevance, this study can be one additional step for contribution in the field of asset pricing model. Similarly, individual investors, institutional investors, future researchers, academicians and general public can be benefited from the findings of this study. Finally, this study is based on 11 out of 12 sectors incorporated for sample selection. Only one trading sector is excluded from the study due to non-availability of data. Future researcher can incorporate this sector too in future if data seems adequate at that time.

References

Ball, R. (1978). Anomalies in relationships between securities' yields and yield-surrogates. *Journal of Financial Economics, 6,* 103 – 126. https://doi.org/10.1016/0304-405X(78)90026-0

Banz, R. W. (1981). The relationship between return and market value of common stocks. *Journal of Financial Economics*, *9*(1), 3-18.

Basu, S. (1983). The relationship between earnings' yield, market value and return for NYSE common stocks: Further evidence. *Journal of Financial Economics*, *12*(1), 129-156. https://doi.org/10.1016/0304-405X(83)90031-4

Bhandari, L. C. (1988). Debt/equity ratio and expected common stock returns: Empirical evidence. *The Journal of Finance*, *43*(2), 507-528.

Black, F. (1972). Capital market equilibrium with restricted borrowing. *The Journal of Business*, *45*(3), 444-455. https://doi.org/10.1086/295472

Carhart, M. M. (1997). On persistence in mutual fund performance. *The Journal of Finance, 52,*57-82. https://doi.org/10.1111/j.1540-6261.1997.tb03808.x

Chan, L. K., Hamao, Y., & Lakonishok, J. (1991). Fundamentals and stock returns in Japan. *Journal of Finance, 46,* 1739 – 1789.

Chiah, M., Chai, D., Zhong, A., & Li, S. (2016). A Better Model? An empirical investigation of the Fama–French five-factor model in Australia. *International Review of Finance*, *16*(4), 595-638. https://doi.org/10.1111/irfifi.12099

Ekaputra, I. A., & Sutrisno, B. (2020). Empirical tests of the Fama-French five-factor model in Indonesia and Singapore. *Afro-Asian Journal of Finance and Accounting, 10*(1), 85. https://doi.org/10.1504/aajfa.2020.104408

Fama, E. F., & French, K. R. (1992). The cross-section of expected stock returns. *The Journal of Finance, 47*(2), 427-465. https://doi.org/10.1111/j.1540-6261.1992.tb04398.x

Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics, 33,* 3-56. https://doi.org/10.1016/0304-405X(93)90023-5

Fama, E. F., & French, K. R. (2015). A five-factor asset pricing model. *Journal of Financial Economics, 116*, 1-22. https://doi.org/10.1016/j.jfineco.2014.10.010

Foye, J. (2018). A comprehensive test of the Fama-French five-factor model in emerging markets. *Emerging Markets Review*, *37*, 199-222. https://doi.org/10.1016/j.ememar.2018.09.002

Guo, B., Zhang, W., Zhang, Y., & Zhang, H. (2017). The five-factor asset pricing model tests for the Chinese stock market. *Pacific-Basin Finance Journal*, *43*, 84-106. https://doi.org/10.1016/j.pacfin.2017.02.001

Jiao, W., & Lilti, J. J. (2017). Whether profitability and investment factors have additional explanatory power comparing with Fama-French three-factor model: Empirical evidence on Chinese stock market. *China Finance and Economic Review*, *5*, 1-19. https://doi.org/10.1186/s40589-017-0051-5

Karki, D., & Ghimire, B. (2016). Explaining stock returns in Nepal: Application of single and multi-factor models. *Journal of Finance and Investment Analysis*, *5*(3), 59-77.

Kostin, K. B., Runge, P., & Mamedova, L. E. (2022). Validity of the fama-french three- and five-factor models in crisis settings at the example of select energy-sector companies during the COVID-19 Pandemic. *Mathematics*, *11*(1), 49. https://doi.org/10.3390/math11010049

Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. *The Review of Economics and Statistics, 471*(1), 13-37. https://doi.org/10.2307/1924119

Markowitz, H. (1952). Portfolio Selection. *The Journal of Finance, 7,* 77-91. https://doi.org/10.1111/j.1540-6261.1952.tb01525.x

Panta, S. B., Phuyal, N., Sharma, R., & Vora, G. (2016). The cross-section of stock returns: An application of Fama-French approach to Nepal. *Modern Economy*, *7*(2), 223. https://doi.org/10.4236/me.2016.72024

Rosenberg, B., Reid, K., & Lanstein, R. (1985). Persuasive evidence of market inefficiency. *Journal of Portfolio Management, 11*, 9 – 17.

Ross, S. (1976). The arbitrage theory of capital asset pricing model. *Journal of Economic Theory, 13,* 341 – 380. https://doi.org/10.1016/0022-0531(76)90046-6

Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *The Journal of Finance, 19*(3), 425-442. https://doi.org/10.1111/j.1540-6261.1964.tb02865.x

Singh, S., & Yadav, S. S. (2015). Indian stock market and the asset pricing models. *Procedia Economics and Finance*, *30*, 294-304.

Stattman, D. (1980). Book values and stock returns. *The Chicago MBA: A Journal of School Papers, 4,* 25-45.