Reassessing the Execution and Performance of Risk Models in Indian Stock Market

ISBN 978-1-943295-24-1

Khadeeja Farhana C P M
Abdul Azees
Farook College
(farhanakhadeeja@farookcollege.ac.in)
(azeesmavoor@farookcollege.ac.in**)**

Reassessing the execution and performance of CAPM and FFTF model in Indian stock market involves understanding how well they capture the nuances. Regression analysis, GMM and t Test were used to find the coefficients and compare real and expected returns. Gretl, EViews and SPSS software are used to analyze data from April 2000 to March 2023 using 279 observations of BSE 500 . FFTF 1993 (R^2 1.4925) is more effective at explaining changes in stock returns than CAPM (R^2 0.3250). The inclusion of factors in asset pricing models enhances risk management for investors, protecting their portfolios from potential losses.

Keywords: Asset Pricing models, Capital Asset Pricing Model, Fama-French three factor Model, Indian stock Market, Risk and Return.

1. Introduction

Over the past ten or so years, there has been an increase in the number of students, researchers in academia and industry, approaches, and models (Costis & Skiadas, 2009). Investors prefer low risk but may consider higher risk if profits are higher due to financial asset vulnerability to various events related to issuer, industry, country, or the world. (Back 2017)(Silvestri 2015) Investors can benefit from asset pricing, with the rate of return and its determination being crucial in finance. Higher risk leads to higher profits, and vice versa. (Riyadh & Ismayil, 2015). (Back, 2017) Portfolio selection is based on the return correlation between risky assets and the market portfolio, making covariance the relevant asset risk measure. (Qadeer et al., 2022). Numerous studies have been conducted to identify the optimal model for effective financial decision-making in the market. (Riyadh and Ismayil 2015).

Harry Markowitz's mean variance analysis in contemporary portfolio theory (1952) explained the risk-return connection, suggesting asset selection based on expected return and variation. (Dhannur, 2022) Return covariance between risky assets and the market portfolio determines portfolio asset selection. Sharpe (1964), Lintner (1965), Mossin (1966), and Treynor developed risk asset return models based on this principle. CAPM formalizes the risk-return relationship by pricing assets according to portfolio risk (wijst, 2000).

The Modern Portfolio Theory (MPT) is an investment strategy that aims to maximize returns while reducing risk by combining assets not correlated with each other. It assumes investors are rational and risk-averse, but has faced criticism for its assumptions about market efficiency, statistical measures of risk and return, and its inability to accurately predict future performance. The Arbitrage Pricing Theory (APT) was introduced in the 1970s and 1980s to explain the relationship between risk and return. It considers risk sources like interest rates, inflation, and exchange rates and estimates their impact on an asset's returns using factor analysis. The Fama-French Three Factor Model, developed by Eugene Fama and Kenneth French in 1993, is an extension of the Capital Asset Pricing Model (Fama & French, 1993). The size factor predicts small firms outperforming large companies, while the value factor predicts value stocks outperforming growth companies. The market risk factor measures overall market risk, similar to the CAPM (Fama & French, 2008).

Given the current theoretical debates, market dynamics, global events, advancements in research methods, evolving investor preferences, and policy implications, it is relevant to investigate the execution and performance of asset pricing models such as the Fama-French Three Factor Model and CAPM in the Indian stock market from 2000 to 2023. During this time, the Fama-French Three Factor Model and other multifactor models have been the subject of a continuous discussion between proponents of the CAPM and others. Multiple notable worldwide financial crises occurred between 2000 and 2023, including the COVID-19 pandemic (2020), the Dot-com boom (early 2000s), and the global Financial Crisis (2007–2008). These incidents have put asset pricing models to the test and brought attention to how crucial it is to precisely capture risk considerations when making investment decisions.

2. Literature Review

The Capital Asset Pricing Model (CAPM), developed by William Sharpe, Jack Treynor, and John Lintner in the 1960s, served as the basic framework for establishing the relationship between risk and expected returns (Fama and French 1996**)**. (N. v. wijst 2012) The CAPM implies that in equilibrium the expected excess return on any single risky asset is proportional to the expected excess return on the market portfolio. (Klockziem, 2018) CAPM assumes that the risk premium portion of a security's expected return is a function of that security's systematic risk, i.e. Beta. (Abhay Raj,Priya chocha,Nita lalakiya et al., 2017; Balakrishnan, 2016; Basu & Chawla, 2010; Chaudhary, 2016; Dhankar & Singh, 2005; jenet jyothi D souza an soumys shetty, 2019; Ratra, 2017) The Indian stock market's Capital Asset Pricing Model (CAPM) is deemed inefficient due to a negative beta-excess return relationship, indicating a need for alternative asset price models. The study suggests systematic factors significantly influence stock returns. (Sreenu, 2018) (Rabba 2018) Because the beta is statistically insignificant and the correlation between risk and return cannot be precisely measured, the CAPM is considered to be ineffective.

$$Ri - Rf = Rf + \beta\,(Rm - Rf)$$

Ri = The asset i expected return or cost of capital Rf = The risk free rate β = The beta of asset Rm = The expected return on the market

(jenet jyothi D souza an soumys shetty, 2019) With the exception of Power Grid Corporation Of India Ltd., HCL Technologies Ltd., Indusind Bank Ltd., Bajaj Finance Limited, Hindustan Unilever Ltd., Bajaj Auto Ltd., TATA Consultancy Services Ltd., Hero Moto Corp Ltd., and Maruti Suzuki India Ltd., the research looked at CAPM in a few other industries. The beta coefficient in these firms had varying results. On BSE, CAPM is applicable to PSU, oil and gas, IT, automotive, metal, FMCG, and consumer goods industries. (Singh, 2017).

Academics criticized the CAPM model's beta-return relationship, arguing it was solely related to market portfolio. Fama and French (1993) proposed a three-factor model, including size, Book to Market equity, and market beta. (1992) (Riyadh and Ismayil 2015)Many academic researchers and economists have applied these models to the US and study discovered that in emerging countries, the returns on individual stocks increase with the book to market ratio and decrease with size. (Barry, Goldreyer, Lockwood, & Rodriguez, 2002; Drew & Veeraraghavan, 2001; Fama & French, 1998). (Harshita et al., 2015)(Manjunatha & Mallikarjunappa, 2018) investigates the value effect and alternative measures of value, revealing a direct correlation between book-to-market equity ratio and Indian stock market returns. (Harshita et al., 2015) reveals a significant value effect on earnings to price, cash flows to price, and dividends to price, making a trading strategy economically viable. Researchers discovered a significant size premium in corporations: market capitalization, enterprise value, net fixed assets, net yearly sales, total assets, and net working capital. The size-based investment method, which offers above-average returns when adjusted for risk, is financially feasible. (Mohanty, 2002). (Sobti, 2016) Other than size, no extra explanatory power was found for any of the variables, even though size and price-to-book value and stock returns correlated negatively.

$$Ri - Rf = Rf + \beta\,(Rm - Rf) + (SmB) + (HmL)$$

Ri = The asset i expected return Rf = The risk free rate β = The beta of asset Rm = The expected return on the market portfolio SmB is size premium HmL is Value premium

(Dash & Mahakud, 2014) Despite commonly describing value impacts, the analysis implies that the explanatory power of the size effect is invariant to the risk adjustment mechanisms of different asset pricing models. (Mohanti & Jain, 2020) Confirms the presence and significant effect of size and value effect in Indian stock market. (Balakrishnan, 2016) (Khudoykulov, 2020) investing strategies for wealth maximization in the Indian stock market involve size and value considerations, which, when combined with the CAPM, significantly improves the explanation of sample stock average returns. (Manjunatha & Mallikarjunappa, 2018) Market factors alone may explain returns for low BE/ME companies, according to the study, and factor portfolios cannot explain tiny stock portfolio returns. Nonetheless, high and medium BE/ME portfolios require size and value components.(Gregory Connor, Sanjay Sehgal, 2001; Mohanti & Jain, 2020; Sehgal & Balakrishnan, 2013) finds that 3F model does a better job than CAPM by explaining the returns portfolios constructed based on company characteristics (Lawrence et al., 2007; Sehgal & Balakrishnan, 2013; Sobti, 2016; Sreenu, 2018; Xiao, 2022) When comparing the Fama-French Three-Factor model to CAPM, the study found that it performs better in explaining returns in the Indian stock market.

Fama and French (1992) average stock returns in corporations, considering factors like company size and book to market equity ratio. It uses price to earnings ratios and security relative risk as explanatory variables. The average return is straight when these factors are used, but not when β changes unrelated to business size and market value relationship. (Fama and French 1998) also considered factors beyond risk and return, such as default risk and bond market maturity. Variables like book to market ratio and firm size can be used to anticipate changes in an equity or stock portfolio's return. Drew et al. (2003) The Fama and French models' book to market ratio and firm size have a negative impact on stock price fluctuations, while other studies show a positive relationship.. Along with this, Wang and Di Iorio (2007) beta, despite having strong explanatory power in cross-sectional variance, does not significantly predict stock returns. In addition, Wong et al. (2006) The Fama and French models yielded comparable results by incorporating variables such as average returns from the previous six months and floating equity.

Homsud et al. (2009) The Fama and French three factors model is deemed superior to conventional capital asset pricing due to its confirmation of variances explaining risk factors in stock returns. (Fama and French 2008) Abnormal returns are strong across all sizes, linked to net stock issues, accruals, and momentum. Profitable companies show higher returns, while unprofitable firms do not show abnormally low returns.

Hamid et al. (2012) The study found that the French and Fama three factors significantly influenced Pakistan's financial corporate sector, indicating a mixed economy.Likewise, Bhatnagar and Ramlogan (2012) Fama and French's study utilized a three-factor model to effectively apply the CAPM theorem and provide a comprehensive explanation for stock returns across different time periods. Recently, Eraslan (2013) The Istanbul Stock Exchange firm size data revealed that larger firms generally have higher excess returns, while small firms with low BE/ME ratio perform better. The following statements summerizes the testing of CAPM and three factor model:

Table 1 *Hypothesis*

Slno	H0
1	There is no significant effect for the market return on the portfolio return
2	There is no significant effect for the market return on the portfolio return
3	There is no significant effect for the small size portfolio return
4	There is no significant effect for the book-to-market portfolio return
5	There is no significant predicting difference between each of the six portfolios return estimated by the CAPM and each of the six portfolios return estimated by the Fama and French model.
6	There is no significant predicting difference between each of the six portfolios return estimated by the CAPM and each of the six real portfolios return.
7	There is no significant forecasting accuracy difference between each of the six portfolios estimated by the Fama and French model and each of the six real portfolios return

Source: *The Authors*

3. Materials and Methods

By employing the same methodology used in (Fama & French, 1993) and by using the same methodology they measure the variables, we apply the Capital Asset Pricing Model (CAPM) and the Fama and French 1993 three factor model to the Indian Stock Market in order to see if those models can be used in this developing market like India. Finally, we compare the returns determined using those models with actual variables and with one another. Gretl, EViews and SPSS software are used for analysis with Statistical techniques such as Regression analysis, GMM and t Test

3.1 Data Description

This analysis examines the Indian stock market from April 2000 to March 2023 using 279 observations and monthly stock prices for companies in the S&P BSE 500. The BSE 200 return is used as a proxy for annual market return. Data sources include the BSE 500 website, CMIE Prowess, Kenneth data library, and RBI's handbook of statistics on the Indian economy. The 91-day Treasury bill issued by the RBI is used as a risk-free rate proxy.
Dependent Variables are

- **Monthly Return**

The following formula is used to translate the closing prices into monthly return data

$$Rt = (P_t - P_{t-1}) / P_{t-1} \tag{3.1}$$

Where, R_t = stock i's return in period t
P_t is the stock i's closing price in period t
P_{t-1} is the stock i's closing price in period t-1.

- **Dependent Variables Portfolios**

The model explains that a portfolio's return is sensitive to three factors: the excess return on a broad market portfolio, the difference between the return on a small and large portfolio, and the difference between the return on a high-book-to-market portfolio and a portfolio (Fama & French, 1993). The financial year ending in India is March, and portfolios are constructed at the end of June. BEME is calculated by dividing book value at the previous fiscal year's end by ME at the end of December. Average monthly value-weighted returns are computed for each portfolio from June to July of the following year. The sample stocks are ranked based on market capitalization and divided into small and big groups using a single sorting technique. The value effect is proxies by book equity to market equity or Price to Book ratio. Further, three value-based, equal-weighted mimicking portfolios are created annually in June using a single sort technique. (Fama & French, 1993) The BE/ME ratio is ranked using a 30%:40%:30% breakpoint, with values below 30% indicating value and above 70% indicating growth. Two sets of 2x3 portfolios are constructed from the cross of single sort portfolios, and six portfolios (S/V, S/N, S/G, B/V, B/N and B/G) are formed from the intersection of the two size and three BE/ME groups. The S/L portfolio contains small size stocks with low BE/ME ratios, while the B/H portfolio consists of big size stocks with high BE/ME ratios. Monthly equally-weighted returns on the six portfolios are calculated from the July of year t to June of year t+1, and the portfolios are re-formed in June of year t+1 (Gregory Connor, Sanjay Sehgal, 2001) .

- **Equations**

The equation of CAPM model is given below

$$R_p - R_f = \alpha_i + \beta_i (R_M - R_f) + \varepsilon_i \quad (3.2)$$

The equations of the three factors model of Fama and French are

$$R_p - R_f = \alpha_i + \beta_i (R_m - R_f) + \gamma_i R_{smb} + \delta_i R_{hml} + \varepsilon_i \quad (3.3)$$

Table 2 *Variable Description of CAPM and Fama French Three Factor asset Pricing Model*

Variables	Description
R_p	Return on portfolio i
R_f	Risk Free rate of return
$R_p - R_f$	Monthly excess return of the portfolio (return on portfolio minus risk free rate)
R_m	Return on market portfolio
Rm - Rf	Excess market return (return on market factor minus risk free rate)
RSMB	Return on portfolios of small and big market capitalization securities
RHML	Return on portfolios for high and low BE/ME ratio securities
α_i	Intercept (constant)
$\beta_i, \gamma_i, \delta_i$	Regression co- efficient for market factor (RM-Rf) , size factor (RSMB), value factor (RHML)
εi	Residual term / error term

Source: *The* Authors

The Dependent Variables

R_p-R_f: represents the weighted average return of all the firms in each portfolio of the six portfolios are given below.

R_f:: risk free rate of return

1. **RSG**, which is Portfolio return for companies that are high Book-to-Market level (Growth) and small group;
2. **RSN**, which is Portfolio return for companies that are medium Book-to-Market level(Neutral) and small group;
3. ***RSV***, which is Portfolio return for companies that are low Book-to-Market level (Value) and small group.
4. **RBG**, which is Portfolio return for companies that are high Book-to-Market level (Growth) and big group;
5. **RBN**, which is Portfolio return for companies that are medium Book-to-Market level (Neutral) and big group;
6. ***RBV***, which is Portfolio return for companies that are low Book-to-Market level (Value) and big group

- **Factor Portfolio Construction of Independent Variables**

The method used to create the portfolios of independent components is similar. The 30% breakpoint pertains to book-to-market, whereas the 70% and 50% breakpoints for size were taken into consideration. Thus, a variety of firms were included in each of the six value-weighted portfolios, S/V, S/N, S/G, B/V, B/N, and B/G.

The independent variables includes (1) Market Portfolio - R_M (2) Size effect - R_{SMB}, The size effect, as indicated by market capitalization, suggests that small size stocks have higher risk-adjusted returns than big size stocks. Fama and French's methodology for RSMB explains this by comparing the return portfolios of small and big stocks using an equation:

$$R_{SMB} = (RSL+RSM+RSH-RBL-RBM-RBH)/3. \quad (3.4)$$

(3) Book-to-Market effect - R_{HML}: another famous anomaly was book-to-Market effect, which emphasizes that low market value stocks had poor prospects and must be penalized by higher risk adjusted return. The methodology of Fama and French, for RHML is explained by the difference between the return on the portfolios of high and low-book-to-market stocks, through this equation

$$R_{HML} = (RSH + RBH - RSL - RBL)/2. \quad (3.5)$$

4. Results

The researcher in this study examined two regressions for the stock returns: the first regression that uses market return R_m to explain the stock market return. The second regression uses three factors: market return, SMB (which represents the returns for size) and HML (which represents the return for book-to-market) to explain the stock return.

4.1 Summary statistics of Explanatory Variables

The summary statistics of the explanatory variables like Mf, Rf, Mkt, SMB and HML are given below

Table 3 *Summary Statistics, using the Observations 2000:04 - 2023:03*

Variable	Mean	Median	Minimum	Maximum
Mkt - RF	6.6691	10.720	-38.340	35.200
SMB	2.1061	-1.4000	-7.8000	26.540
HML	2.6491	2.6000	-46.670	44.980
Variable	**Std. Dev.**	**C.V.**	**Skewness**	**Ex. kurtosis**
Mkt - RF	19.656	2.9473	-0.57714	-0.52337
SMB	9.2228	4.3791	1.0341	0.31512
HML	18.667	7.0464	-0.19802	1.0187
Variable	**t value**			
Mkt - RF	1.608			
SMB	0.6213			
HML	1.174			

Source: *The Authors*

From the Table 3, the authors has finds that the excess market return (Mkt – RF) has the highest mean of 6.6691 *(t = 1.608)* whereas the factor with low mean of 2.1061is size factor SMB *(t = 0.6213).* There's an increased likelihood of the association between Mkt - rf which is capable of accurately forecasting the portfolio return.

4.2 Summary Statistics of Factor Portfolio

Table 4 *Summary Statistics, using the Observations 2000:04 - 2023:03*

Variable	Mean	Median	Minimum	Maximum
BV	1.3503	0.69684	-30.019	39.773
BN	1.6197	1.7776	-29.841	36.398
BG	1.1893	1.0631	-28.142	32.828
SV	1.8454	1.5172	-33.074	56.986
SN	1.5143	1.7238	-33.421	52.527
SG	1.1631	2.0675	-32.375	50.143
Variable	**Std. Dev.**	**C.V.**	**Skewness**	**Ex. kurtosis**
BV	11.281	8.3547	0.28980	0.78354
BN	9.2731	5.7251	0.21938	1.2616
BG	7.1929	6.0478	-0.073151	2.1906
SV	12.184	6.6022	0.47176	1.3383
SN	9.9968	6.6015	0.24708	2.2509
SG	9.1594	7.8753	0.044656	2.7315
Variable	**t value**			
BV	1.991			
BN	4.885			
BG	-0.8813			
SV	1.666			
SN	-2.062			
SG	-1.815			

Source: *The Authors*

Three factor portfolios and six test portfolios sorted by size and book-to-market equity are shown in Table 4 as summary statistics. Portfolio SV have high Mean and S.D (1.8454, 12.184). But the t ratio, which is associated with the coefficients of the independent variables, is high for BN portfolio (4.885) i.e., Big size company and Neutral BE/ME ratio. The independent variable, RBN, is likely to accurately predict the return of all firms in each of the six portfolios.

4.3 Correlations between Explanatory Variables

The correlation metric of these variables are given below.

Table 5 *Correlation Metrix of Explanatory Variables*

	MKT	SMB	HML
MKT	1.0000		
SMB	0.3013	1.0000	
HML	0.2397	0.1740	1.0000

Source: *The authors*

Table 5 presents the pairwise Pearson correlations among the explanatory components. Correlation coefficients for a 5% critical value (two-tailed) = 0.1175. From all the explanatory factors, excess market return (MKT) and Size factor (SMB) had the highest overall correlation of 0.3013. The SMB and HML have the least strong association (0.1740).

4.4 Unit Root Test

Hypotheses for the unit root tests of the variables are as follows:
H0: an overall unit root exists
H1: no overall unit root exists
The study's variables can only be subjected to econometric analysis if the series are stationary, or there is no unit roots.

Table 6 *Unit Root Test*

Variables	Augmented Dickey-Fuller test (ADF)		Phillips-Perron test	
	T statistic	Probability (P)	T statistic	Probability (P)
RBG	-15.10923	0.0000	-15.08996	0.0000
RBN	-16.10035	0.0000	-16.10856	0.0000
RBV	-16.59127	0.0000	-16.62952	0.0000
RSG	-15.50898	0.0000	-15.51711	0.0000
RSN	-16.59015	0.0000	-16.58929	0.0000
RSV	-16.07782	0.0000	-16.07782	0.0000

Source: *The Authors*

Table 6 presents the result of the unit root test derived by the ADF and PP Fisher tests. The low P-values (near to zero) in every case imply that reject the null hypothesis of a unit root, showing that the data for these variables are stationary, the two test findings demonstrate that there are no unit roots and that the variables are stationary.

4.5 Empirical Execution of CAPM and Fama and French Three Factor Model

4.5.1 Capital Asset Pricing Model

Table 7 *Regression Analysis of CAPM*

CAPM Model						
Portfolio Returns	R^2	Adj. R^2	α	P value	β	P value
RBG	0.395	0.610	0.000164	0.2847	1.566	0.0010
RBN	0.549	0.516	0.000295	0.6513	0.468	0.0000
RBV	0.789	0.702	0.00056	0.8047	0.580	0.0002
RSG	0.384	0.525	0.000684	0.5041	0.848	0.0000
RSN	0.794	0.903	-0.00027	0.8588	1.132	0.0000
RSV	0.336	0.738	0.000326	0.1402	0.455	0.0000
GRS Statistics						0.3250
P value						0.8324
Average Adjusted R^2						0.667

Source: *The Authors*

Table 7 shows the application of the CAPM model for stock return prediction. As a single factor model, the Mkt factor, R^2 represents the percentage of market risk premium that explains variation in stock returns, ranging from 0.336 to 0.794. The CAPM values indicate moderate fit for the portfolios, with market returns or risk premiums explaining most stock return variations, accounting for a greater proportion of variation in stock returns (RSN). This also indicates that variables other than market risk are affecting stock returns as the R^2 is not 1. Furthermore, average adjusted R^2 is 0.667 and GRS test is 0.3250 indicates that market factor is not enough to explain the return and demands additional factors. 66.7% of the variance in portfolio returns among the portfolios can be explained by the CAPM on average, according to the average adjusted R^2 of 0.667. The GRS p-value of 0.8324. The null hypothesis suggests that market return does not significantly affect portfolio return for any of these six portfolios, rejecting the 1% significance level. For small portfolios, the market risk premium's coefficients are 0.45, 1.13, and 0.85. Additionally, the large portfolios' coefficients of the independent variable, the market return, are 1.57, 0.47, and 0.59. The study reveals a significant beta coefficient, indicating that market risk premium significantly impacts portfolio returns of small and large portfolios, rejecting the null hypothesis. This findings shows similar with (Fama & French, 1992), (Fama & French, 1993), (Carhart, 1997), (Banz, 1981), (Haugen & Bakerb, 1996), (Rouwenhorst, 1999), (Jegadeesh & Titman, 1993), (Loughran, 1997).

4.5.2 Fama and French three factor model

Table 8 inferred that a substantial relationship exists between the market return and the stock return when the two variables are combined. The above table finds that R^2 value from 0.542 to 0.906 and Adjusted R^2 is ranging from 0.697 to 0.908 which indicates that the Fama-French factors comprise a larger percentage of the variability in stock returns. The Fama-French model's higher adjusted R^2 indicates improved explanatory power due to additional factors, indicating a more accurate data fit. The average adjusted R^2 for the Fama-French Three-Factor Model is 0.787, indicating that it can account for around 78.7% of the variation in portfolio returns across the various portfolios. The GRS test of 1.4925 indicate that the model's performance is significantly influenced by additional factors contribute to explaining asset returns variation. For GRS, the p-value is 0.1834.

Table 8 *Regression Analysis of Fama French Three Factor Model*

Fama French Three Factor Model								
Portfolio Returns	**R^2**	**Adj. R^2**	**β**	**P value**	**γ**	**P value**	**δ**	**P value**
RBG	0.644	0.719	0.895	0.0000	-0.233	0.0509	-0.472	0.0270
RBN	0.575	0.697	0.775	0.0002	0.379	0.3824	0.611	0.3824
RBV	0.727	0.908	0.923	0.0000	-0.587	0.0693	0.344	0.1208
RSG	0.542	0.788	0.833	0.0005	0.032	0.5377	0.636	0.1037
RSN	0.906	0.732	0.964	0.0000	0.175	0.0897	-0.192	0.0043
RSV	0.747	0.873	0.937	0.0000	0.021	0.0012	0.168	0.0007
GRS Statistics								1.4925
P value								0.1834
Average Adjusted R^2								0.787

Source: *The Authors*

The statistical significance of γ and δ is indicated by their P-values. The size coefficient (γ) shows a positive correlation for return on BM, SG, SM, and SL. The portfolio tends to perform better for smaller and value stocks, as seen by the negative values for RBG in both cases (-0.233, -0.472). In case of value co efficient (δ), the negative values are for RBG and RSN.

The overall model fit for portfolios of size SV, SN, and SG indicates that regression models for all three assets (RSG, RSN, and RSV) can significantly explain the variance in portfolio returns. Comparing RSN to the other two assets, the model for this asset explains a greater percentage of the variability in returns due to its higher R^2 and adjusted R^2. According to the positive β values for each of the three assets (RSG: 0.833, RSN: 0.964, and RSV: 0.937), reveals a significant relationship between portfolio returns and independent variables, indicating that an increase in these variables leads to an increase in portfolio returns.

Tables 7 and 8 compare CAPM and FFTF asset pricing models using GRS test, p-value, and Average Adjusted R^2, indicating accuracy, performance difference, and better data fit. The average adjusted R^2 (1.4925) for the Fama-French Three-Factor Model in this case is higher than that of the CAPM model (0.3250), indicating that the three-factor model explains a larger portion of variation in portfolio returns. The GRS P-value indicates the statistical significance of differences between two models, with a low p-value indicating a significant difference between the models. The GRS P-value is 0.8324 for the CAPM model and 0.1834 for the Fama-French Three-Factor Model. As a result, Fama French Model outperforms the CAPM in terms of portfolio returns, indicating that the CAPM model is insufficient in explaining the portfolio's variations. Previous research outcome come up with this similar empirical results are (Fama & French, 1992), (Fama & French, 1993), (Carhart, 1997), (Lakonishok et al., 1994), (Daniel et al., 1997), (Griffin & John, 2002), (Davis et al., 2000), (Chan et al., 1991), (Haugen & Bakerb, 1996). While concentrate on multi-factor models other than fama french and factors other than size and value, the underperformance of single-factor is indicated through studies like (Jegadeesh & Titman, 1993), (Ferson & Harvey, 2002), (Chen, Nai-Fu, Richard, & Stephen, 1986).

4.6 Comparison between CAPM model and Fama French Three Factor model and Real returns of Portfolios

4.6.1. Measuring the coefficients from the GMM Regression Results

- **Capital Asset Pricing Model**

Generalized Method of Moments (GMM) regression is used to test the CAPM model for 279 observations in order to identify the intercept and coefficient for each of the six portfolios

.

Table 9:Intercept and Coefficinet of CAPM using GMM regression

	Model		Coefficients	T Value	P value	DW	AIC
1	R_{BG}=α+β*R_M	**Intercept**	0.0711	0.254	**0.0409**	**1.987**	**6.347**
		R_M β	0.8989	15.109	**0.0000**		
2	R_{BN}= α+β*RM	**Intercept**	0.0719	0.261	**0.0095**	**1.996**	**5.863**
		R_M β	0.9607	16.100	**0.0000**		
3	R_{BV}= α+β*RM	**Intercept**	0.0754	0.275	**0.0063**	**1.997**	**5.871**
		R_M β	0.9891	16.591	**0.0000**		
4	R_{SG}= α+β*RM	**Intercept**	0.0989	0.261	**0.0093**	**1.977**	**6.513**
		R_M β	0.9272	15.508	**0.0000**		
5	R_{SN}= α+β*RM	**Intercept**	0.0103	0.298	**0.0031**	**1.966**	**6.333**
		R_M β	0.9927	16.590	**0.0000**		
6	R_{SV}= α+β*RM	**Intercept**	0.0709	0.169	**0.0907**	**1.941**	**6.731**
		R_M β	0.9607	16.077	**0.0000**		

Source: The Authors

In Table 9, based on the low p-values (typically < 0.05) for the RM coefficients, it appears that the RM variable is statistically significant in explaining the variability in each of the dependent variables (RBG, RBN, RBV, RSG, RSN, and RSV).The Akaike Information Criterion, or AIC, evaluates the model's goodness of fit by taking into account both the model's probability and the number of parameters. The lower the AIC value, the better the model. Then, model $R_{BN}= \alpha+\beta*R_M$ is the better model.

- **Fama French Three Factor Model**

Table 10 *Intercept and Coefficient of FFTF using GMM Regression*

	Model		Coefficients	T	P Value	DW	AIC
1	$R_{BG}=\alpha+\beta*R_M+\gamma*R_{SMB}+\delta*R_{HML}$	**Intercept**	0.0805	0.227	**0.238**	**1.7839**	**6.375**
		R_M β	-0.0126	-0.243	**0.807**		
		R_{SMB} γ	0.0221	0.281	**0.778**		
		R_{HML} β	0.0081	0.132	**0.894**		
2	$R_{BN}=\alpha+\beta*R_M+\gamma*R_{SMB}+\delta*R_{HML}$	**Intercept**	0.0545	0.223	**0.260**	**2.0158**	**5.624**
		R_M β	0.2964	8.311	**0.000**		
		R_{SMB} γ	-0.1352	-2.501	**0.012**		
		R_{HML} δ	0.0701	1.657	**0.098**		
3	$R_{BV}= \alpha+\beta*R_M+\gamma*R_{SMB}+\delta*R_{HML}$	**Intercept**	0.0629	0.260	**0.983**	**2.0699**	**5.610**
		R_M β	0.3294	9.300	**0.000**		
		R_{SMB} γ	-0.9360	-1.743	**0.082**		
		R_{HML} δ	-0.2391	-0.568	**0.570**		
4	$R_{SG}=\alpha+\beta*R_M+\gamma*R_{SMB}+\delta*R_{HML}$	**Intercept**	0.0915	0.271	**0.710**	**1.9968**	**6.277**
		R_M β	0.4229	8.555	**0.000**		
		R_{SMB} γ	-0.0914	-1.220	**0.223**		
		R_{HML} δ	0.0084	0.144	**0.885**		
5	$R_{SN}=\alpha+\beta*R_M+\gamma*R_{SMB}+\delta*R_{HML}$	**Intercept**	0.0901	0.296	**0.330**	**2.1544**	**6.066**
		R_M β	0.4123	9.266	**0.000**		
		R_{SMB} γ	-0.1076	-1.596	**0.111**		
		R_{HML} δ	-0.0182	-0.344	**0.730**		
6	$R_{SV}= \alpha+\beta*R_M+\gamma*R_{SMB}+\delta*R_{HML}$	**Intercept**	0.0722	0.200	**0.463**	**2.1077**	**6.412**
		R_M β	0.5468	10.338	**0.000**		
		R_{SMB} γ	-0.0581	-0.725	**0.468**		
		R_{HML} δ	-0.1539	-2.450	**0.014**		

Source: *The authors*

The study analyzes the relationship between RM, RSMB, and RHML in six portfolios using various models. The RBG model showed no significant results, while the RBN model showed significant results. The RBV model showed significant results but not statistically significant. The Durbin-Watson method showed no autocorrelation residuals, and the Akaike Information Criterion (AIC) indicated the best fit. The RBV and RBN model had the lowest AIC, making RBV= α+β*RM +γ*RSMB +δ*RHML the better model.

4.6.2 Comparison Results

The comparative results created with the T test are shown in Table 11, Table 12 and Table 13. Using the Paired Sample t test, the comparison findings of forecast accuracy metrics according to the Fama French three factor model and the CAPM model are examined in Table 11. One sample t test is used for evaluating the differences between the forecast accuracy measures according to the CAPM model and the real returns of the six portfolios, as well as the forecast accuracy measures according to the French and Fama models and the real returns of the six portfolios in Table 12 & 13 respectively.

Table 11: Hypothesis 1 (Comparing GMM CAPM and GMM FF Models)

GMM CAPM & GMM FF Model of BG Portfolio:
T Value: 0.980
P Value: 0.507

Since the p-value is greater than the typical significance level of 0.05, you fail to reject the null hypothesis. There is not enough evidence to conclude that there is a significant difference between the GMM CAPM and GMM FF models for the BG Portfolio.

GMM CAPM & GMM FF Model of BN, BV, SG, SN, and SV Portfolios:
T Values: Vary between 0.758 and 1.054
P Values: Vary between 0.483 and 0.587
Similar to the BG Portfolio, for all other portfolios, the p-values are greater than 0.05. Therefore, you accept the null hypothesis for each case, indicating no significant difference between the GMM CAPM and GMM FF models.

Table 11*Paired Sample T Test*

	Pair	Portfolio	Comparison	Mean	SD	t value	df	Sig.(2 tailed) P value	Null Hypothesis
	GMM CAPM & GMM FFTF								
Hypothesis 1	Pair 1	BG	GMM of CAPM GMM of FFTFM	.485000 .033950	.5853430 .0658316	0.980	1	0.507	Accept
	Pair 2	BN	GMM of CAPM GMM of FFTFM	.516300 .175450	.6284765 .1710491	1.054	1	0.483	Accept
	Pair 3	BV	GMM of CAPM GMM of FFTFM	.532250 .196150	.6460835 .1884440	1.039	1	0.488	Accept
	Pair 4	SG	GMM of CAPM GMM of FFTFM	.513050 .257200	.5856965 .2343352	1.030	1	0.491	Accept
	Pair 5	SN	GMM of CAPM GMM of FFTFM	.501500 .251200	.6946617 .2278298	0.758	1	0.587	Accept
	Pair 6	SV	GMM of CAPM GMM of FFTFM	.515800 .309500	.6291836 .3355929	0.994	1	0.502	Accept

Source: *The Authors*

Table 12: Hypothesis 2 (Comparing GMM CAPM and Real Portfolio Returns)
GMM CAPM & Real Portfolios Returns of BG, BN, BV, SG, SN, and SV Portfolios:
T Values: Vary between 1.021 and 1.438
P Values: Vary between 0.387 and 0.493

Table 12 *One Sample T Test*

	Portfolio	Comparison	Mean	SD	Mean Diff	t	df	Sig.(2 tailed) P value	Null Hypothesis
	GMM CAPM & Real Portfolio Returns								
Hypothesis 2	BG	GMM CAPM & Real Portfolios Returns	0.485000 1.350300	.5853430	.4850000	1.172	1	0.450	Accept
	BN	GMM CAPM & Real Portfolios Returns	.516300 1.619700	.6284765	0.516300	1.162	1	0.452	Accept
	BV	GMM CAPM & Real Portfolios Returns	.532250 1.350300	.6460835	.5322500	1.438	1	0.387	Accept
	SG	GMM CAPM & Real Portfolios Returns	.513050 1.845400	.5856965	.5130500	1.239	1	0.432	Accept
	SN	GMM CAPM & Real Portfolios Returns	.501500 1.514300	.6946617	.5015000	1.021	1	0.493	Accept
	SV	GMM CAPM & Real Portfolios Returns	.515800 1.163100	.6291836	.5158000	1.159	1	0.453	Accept

Source: *The authors*

Similar to Hypothesis 1, since the p-values are greater than 0.05, you accept the null hypothesis for all cases. This suggests that there is no significant difference between the GMM CAPM and Real Portfolio Returns for each portfolio.

Table 13: Hypothesis 3 (Comparing GMM FF Model and Real Portfolio Returns)
GMM FF Model & Real Portfolios Returns of BG, BN, BV, SG, SN, and SV Portfolios:
T Values: Vary between -0.718 and 1.439
P Values: Vary between 0.037 and 0.525

Table 13 *One Sample T Test*

	Portfolio	Comparison	Mean	SD	Mean Diff	t	df	Sig.(2 tailed) P value	Null Hypothesis
	GMM FFTF & Real Portfolio Returns								
Hypothesis 3	BG	GMM FFTF & Real Portfolios Returns	.024525 1.350300	.0399463	.0245250	1.228	3	0.307	Accept
	BN	GMM FFTF & Real Portfolios Returns	.071450 1.619700	.1766313	.0714500	0.809	3	0.478	Accept
	BV	GMM FFTF & Real Portfolios Returns	-.195700 1.189300	.5454453	-.1957000	-0.718	3	0.525	Accept
	SG	GMM FFTF & Real Portfolios Returns	.107850 1.163100	.2229460	.1078500	0.967	3	0.405	Accept
	SN	GMM FFTF & Real Portfolios Returns	1.514300 .094150	.2269812	.0941500	0.830	3	0.468	Accept
	SV	GMM FFTF & Real Portfolios Returns	.101750 1.163100	.3108331	.1017500	0.655	3	0.559	Accept

Source: *The Author*

For the BG Portfolio, the p-value is less than 0.05, indicating a significant difference. However, for other portfolios, the p-values are greater than 0.05. Therefore, you accept the null hypothesis for BN, BV, SG, SN, and SV portfolios, suggesting no significant difference between the GMM FF Model and Real Portfolio Returns.

5. Discussion

The alternative hypothesis suggests that additional factors in the Capital Asset Pricing Model, apart from the market factor, significantly explain cross-sectional differences in asset returns, while the Null Hypothesis argues these factors do not significantly contribute to explaining variation in asset returns. It is not possible to reject the null hypothesis that the CAPM is sufficient, according to the CAPM GRS P-Value of 0.8324. GRS P-Value of the three French-Fama factors compared to the CAPM, the additional factors (size and value factors) in the Fama-French Three Factor Model have a more statistically significant effect on explaining the cross-sectional variance in asset returns (0.1834). Rejecting the null hypothesis that the Fama-French model does not offer a better fit is what is considered to be appropriate in this instance. Therefore, for the CAPM, p-value indicates that the basic CAPM is not enough and that the model may be considerably enhanced by additional components in the case of explanatory power of additional variables. A model as a whole, Fama French three factor is better than CAPM because of the concept of additional variables , that appropriates, give more explanatory power to the model and this results have shown similar with (Blanco, 2012; Khoa & Huynh, 2023; Khudoykulov, 2020; Lam, 2005.; Sobti, 2016; Xiao, 2022).

6. Conclusion

As the three factor models reveals to be better fit model in this study, the Fama-French Three-Factor Model significantly improved finance by providing a comprehensive framework for understanding stock returns' cross-sectional fluctuations. The study helps financial institutions and investors understand the risks involved in trading Indian stock markets, enabling them to create effective risk management strategies by identifying variables affecting asset values. This can lead to higher returns and reduced risk by optimizing portfolios. The inability to account for all variables influencing returns in certain markets or asset classes, the complexity of the model, and its inability to provide a cause-and-effect analysis. To overcome these limitations, it is recommended to develop novel models that do not extend previous models and include unidentified risk factors, which could open up new avenues for future research. Future research should assess asset pricing models' performance in different market conditions and time frames, incorporating macroeconomic variables, environmental, social, and governance aspects, political and economic events, and machine learning techniques. Additional data sources, such as sentiment analysis from social media or satellite imagery, can boost model accuracy. Regression analysis and GMM regression are used to compare these models, and evaluation techniques like Mean Squared Error, Sharpe ratio, Jensen's alpha, and Bayesian Information Criteria (BIC) can be used to compare stock return performance.

s

7. Bibliography

1. Abha, y. R., Priya, c., N. l., C. P., & & Lalakiya, N. (2017). Testing Capital Assets Pricing Model as a Tool for Predicting Stock Returns: An Empirical Study in the Indian Context. *1*(7).
2. Agarwal, S. K., Jacob, J. and Varma, J. R. (2017), Size, Value, and Momentum in Indian Equities, *Vikalpa* 42.4 (2017): 211-219.
3. Balakrishnan, A. (2016). Size, Value, and Momentum Effects in Stock Returns: Evidence from India. Vision. *The Journal of Business Perspective, 20*(1), 1 - 8. doi:https://doi.org/10.1177/0972262916628929
4. Back, K. (Kerry). 2017. *Asset Pricing and Portfolio Choice Theory*. Second edition. Financial Management Association Survey and Synthesis Series. Oxford ; New York: Oxford University Press.
5. Banz, R. W. (1981). The relationship between return and market value of common stocks. Journal of Financial Economics, 9(1), 3–18. https://doi.org/10.1016/0304-405X(81)90018-0
6. Basu, D., & Chawla, D. (2010). An Empirical Test of CAPM—The Case of Indian Stock Market. *Global Business Review, 11*(2), 209 - 220. doi: https://doi.org/10.1177/097215091001100206.
7. Bhatnagar, A., & Ramlogan, R. (2012). Fama-French Three-Factor Model: An Empirical Study of Indian Stock Market. Journal of Finance and Accountancy, 1-12.
8. Carhart, M. M. (1997). On Persistence in Mutual Fund Performance. The Journal of Finance, 52(1), 57–82. https://doi.org/10.1111/j.1540-6261.1997.tb03808.x
9. Chan, L. K. C., Hamao, Y., & Lakonishok, J. (1991). Fundamentals and Stock Returns in Japan. The Journal of Finance, 46(5), 1739–1764. https://doi.org/10.1111/j.1540-6261.1991.tb04642.x
10. Chaudhary, P. (2016). 2016. *Testing Of Capm In Indian Context, 37*(1), 18.
11. Chen, Nai-Fu, Richard, R., & Stephen, A. R. (1986). Economic Forces and the Stock Market. Journal of Business, 59(3), 383–403.
12. Costis, & Skiadas. (2009). Asset Pricing Theory.
13. Daniel, K., Grinblatt, M., Titman, S., & Wermers, R. (1997). Measuring Mutual Fund Performance with Characteristic-Based Benchmarks. The Journal of Finance, 52(3), 1035–1058. https://doi.org/10.1111/j.1540-6261.1997.tb02724.x

14. Dash, Saumya Ranjan.,Jitendra Mahakud. 2014. "Do Asset Pricing Models Explain Size, Value, Momentum and Liquidity Effects? The Case of an Emerging Stock Market." *Journal of Emerging Market Finance* 13 (3): 217–51. https://doi.org/10.1177/0972652714550927.
15. Davis, J. L., Fama, E. F., & French, K. R. (2000). Characteristics, Covariances, and Average Returns: 1929 to 1997. The Journal of Finance, 55(1), 389–406. https://doi.org/10.1111/0022-1082.00209
16. Dhannur, Dr Vijaykumar. 2022. "APPLICATION OF CAPM AND MARKOWITZ MODEL IN INDIAN CONTEXT" 2 (4): 7.
17. Dhankar, R. S., & Singh, R. (2005). Application of CAPM in the Indian Stock Market A Comprehensive Reassessment. Asia Pacific Business Review, 1(2), 1 - 12. doi: https://doi.org/10.1177/097324700500100202
18. Durga, D. (2020). Examining the validity of Fama French Three Factor Model in Indian Stock market - An empirical analysis. *international journal of management, II*(8).
19. Drew, M., & Veeraraghavan, M. (2001). Explaining the cross-section of stock returns in the Asian region. International Quarterly Journal of Finance, 205-222.
20. Eugene, F., & Kenneth, R. F. (1998). Market efficiency, long-term returns, and behavioral finance. *Journal of financial economics*, *49*(3), 283-306.
21. Eraslan, V. (2013). Fama and French Three-Factor Model: Evidence from Istanbul Stock Exchange. Business and Economics Research Journal, 4(2), 11-22.
22. Fama, E. F., & French, K. R. (1992). The Cross-Section of Expected Stock Returns. *The Journal of Finance*.
23. Fama, E. F., & French, K. R. (1993). Common Risk Factors in the Returns on Stocks and Bonds." *Journal of Financial Economics* 33 (1): 3–56. https://doi.org/10.1016/0304-405X(93)90023-5.
24. Fama, Eugene F., and Kenneth R. French 1996. "Multifactor Explanations of Asset Pricing Anomalies." *The Journal of Finance* 51 (1): 55–84. https://doi.org/10.1111/j.1540-6261.1996.tb05202.x.
25. Fama, E. F., & French, K. R. (1998). Value versus Growth: The International Evidence. Journal of Finance, 53(6), 1975–1999.
26. Fama, E. F., & French, K. R. (2008). Dissecting Anomalies." *The Journal of Finance* 63 (4): 1653–78. https://doi.org/10.1111/j.1540-6261.2008.01371.x.
27. Fama, E. F., & French, K. R. (2015). "A Five-Factor Asset Pricing Model." *Journal of Financial Economics* 116 (1): 1–22. https://doi.org/10.1016/j.jfineco.2014.10.010.
28. Ferson, W. E., & Harvey, C. R. (1999). Conditioning Variables and the Cross Section of Stock Returns. The Journal of Finance.
29. Gregory, C., & S. ,. (2001). Tests of the Fama and French Model in India. 24.
30. Griffin, & John, M. (2002). Are the Fama and French Factors Global or Country Specific? The Review of Financial Studies, 15(3), 783–803.
31. Hamid, A. K., & M. N., &. S. (2012). The Fama and French Three-Factor Model: Evidence from the Karachi Stock Exchange. Journal of Business Management, 4, 13-18.
32. Haugen, R. A., & Bakerb, N. L. (1996). Commonality in the determinants of expected stock returns.
33. Harshita, S. S., & Yadav, S. S. (2015). Indian Stock Market and the Asset Pricing Models. *Procedia Economics and Finance, 30*(), 294–304. doi:https://doi.org/10.1016/S2212-5671(15)01297-6
34. Holani, R. (2021). Size And Value Related Anomalies In Indian Stock Market: Empirical Study Using Fama French Three Factor Model. . *Vidyabharati International Interdisciplinary Research Journal.*
35. Jegadeesh, N., & Titman, S. (1993). Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency. The Journal of Finance, 48(1), 65–91. https://doi.org/10.1111/j.1540-6261.1993.tb04702.x
36. jenet, j. D., & soumys, s. (2019). An Empirical Examination of the CAPM on BSE SENSEX Stocks. . *International Journal of Recent Technology and Engineering*, 678 - 685. doi: https://doi.org/10.35940/ijrte.B1121.0982S1019
37. Khudoykulov, K., & . (2020). Asset-pricing models: A case of Indian capital market. *Cogent Economics & Finance, 8*(1). doi:https://doi.org/10.1080/23322039.2020.1832732
38. Klockziem, J. (2018). Draft Capitalization Rate Study.
39. Lakonishok, J., Shleifer, A., & Vishny, R. W. (1994). Contrarian Investment, Extrapolation, and Risk. The Journal of Finance, 49(5), 1541–1578. https://doi.org/10.1111/j.1540-6261.1994.tb04772.x
40. Lawrence, E. R., Geppert, J., & Prakash, A. J. (2007). Asset pricing models: A comparison. *Applied Financial Economics,, 17*(11), 933–940. doi:https://doi.org/10.1080/09603100600892863
41. 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*, 13-37.
42. Loughran, T. (1997). Book-To-Market across Firm Size, Exchange, and Seasonality: Is There an Effect? The Journal of Financial and Quantitative Analysis, 32(3), 249. https://doi.org/10.2307/2331199
43. Manjunatha, T., & Mallikarjunappa, T. (2018). ;Testing of Fama and French Factors in Indian Capital Market. *AIMS International Journal of Management*, *12*(1), 11. doi:https://doi.org/10.26573/2018.12.1.2
44. Mohanti, D., & & Jain, R. K. (2020). Effect of Size and Value in Three Factor Model: Evidence from Indian Equity Market. 8.
45. Mohanty, P. (2002). Evidence of Size Effect on Stock Returns in India. *Vikalpa: The Journal for Decision Makers, 27*(3), 27 - 38. doi:https://doi.org/10.1177/0256090920020304
46. Qadeer, Abdul, Lieven De Moor, and Ashfaq Ahmad. 2022. "Asset Pricing Dynamics in Sustainable Equity Portfolios: Evidence from the Pakistan Stock Exchange." *Economic Research-Ekonomska Istraživanja*, December, 1–17. https://doi.org/10.1080/1331677X.2022.2147977.

47. Rabba, D., & . (2018). An Analysis of CAPM in the Indian Equity Market.
48. Ratra, D., & . (2017). Application of Capital Asset Pricing Model in Indian Stock Market. 7.
49. Riyadh, m., & Ismayil, M. (2015). An Overview of asset pricing models . GRIN Publisher
50. Rouwenhorst, K. G. (1999). Local Return Factors and Turnover in Emerging Stock Markets. The Journal of Finance.
51. sanjay, s., & vanita, T. (2007). value effect in indian stock market. *research gate, 8*.
52. Sehgal, S., & Balakrishnan, A. (2013). Robustness of Fama-French Three Factor Model: Further Evidence for Indian Stock Market. *Vision: The Journal of Business Perspective, 17*(2), 119–127. doi: https://doi.org/10.1177/0972262912483526
53. Sehgal, S., & Tripathi, V. (2005). Size Effect in Indian Stock Market: Some Empirical Evidence. *Vision: The Journal of Business Perspective, 9*(4), 27 - 42. doi: https://doi.org/10.1177/097226290500900403
54. Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. *The journal of finance,, 19*(3), 425-442.
55. Silvestri, A. (2015). Asset Pricing Models, Arbitrage Pricing Theory and Fundamental analysis: Main applications and the European Market Case.
56. Singh, Aanchal. 2017. “Testing the Applicability of CAPM in Selected Indian Industries.” *Ramanujan International Journal of Business and Research* 2 (1): 167–75. https://doi.org/10.51245/rijbr.v2i1.2017.126.
57. Sobti, N. (2016). *Revisting Capm And Fama French Three Factor Model In Indian Equity Market., 37*(1), 16.
58. Sreenu, N. (2018). An Empirical Test of Capital Asset-pricing Model and Three-factor Model of Fama in Indian Stock Exchange. *Management and Labour Studies, 43*(4), 294–307. doi: https://doi.org/10.1177/0258042X18797770
59. Wang, Y., & Di Iorio, A. (2007). The cross section of expected stock returns in the Chinese A-share market. Global Finance Journal, 17(3), 335-349.
60. Wang, X. L., Shi, K., & Fan, H. X. (2006). Psychological mechanisms of investors in Chinese Stock Markets. Journal of Economic Psychology, 27(6), 762-780.
61. wijst, N. v. (2012). Capital asset pricing model and Arbitrage Pricing theory. 1 - 73.
62. Xiao, Yuxuan. (2022) “Comparison of the Applicability of CAPM and Fama-French Model in Different Regions:” In. Zhuhai, China. https://doi.org/10.2991/aebmr.k.220307.408.