

69

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## Contents

- Testing Alternative Models for Forecasting Volatility in Stock Futures Market: A Linear Approach K. Srinivasan, Malabika Deo, B. Murugesan 5-14
- Are Asian Stock Markets Weak-Form Efficient: An Evidence from India Aman Srivastava 15-21
- Application of Fama and French Three Factor Model and Stock Return Behavior in Indian Capital Market Kiran Mehta and Ramesh Chander 22-40
- Portfolio Risk and Return Relationship – An Empirical Study A. Jeyachitra, M. Selvam and J. Gayathri 41-47 ✓
- Financial Sustainability of Microfinance Institutions: A New Model Approach Anand Rai, Anil Kanwal, Meghna Sharma 48-53
- Dynamic Delta Hedging Satyendra Kumar Sharma, Arun Kumar Vaish, Rajan Pandey and Charu Gupta 54-69
- Customer Relationship Management in Personal Computer Manufacturing Industry in Malaysia: An Empirical Study of Five Major Global Players M. Saeed, Sanket Vij, and T. S. Men 70-78
- Global Competitiveness in the Steel Industry Paroma Mitra Mukherjee and Dilip Roy 79-87
- Development of Scale to Measure Supplier Selection, Supply Effort Management and Organizational Performance D. M. Sezhiyan and T. Nambirajan 88-99
- An Analysis of Buying Behavior of Rural and Urban Consumer in Sagar District with Reference to Utility Pattern of Mobile Phone Anil Mishra 100-107
- Predicting Repeat Purchase Behaviour: An Indian Experience Bikran Jit Singh Mann and Rashmi 108-117
- Life Values and Perceived Occupational Stress among Cosmopolitan (Scientific) and Local (Administrative)-Oriented Scientists in R & D Organization S. Subramanian 118-125
- Gender Perspective on Conflict Resolution Styles of Aspiring Indian Managers Shweta and Shilpa Jain 126-133
- Organizational Role Stress: An Empirical Study on Insurance Employees Swati Goyal and Vinay Kashyap 134-142
- An Evaluation of Client's Expectation from their Ad-Agencies and Ad-Agencies Expectation from their Clients P.G. Arul 143-153
- Tourism Industry in Andhra Pradesh and Its Financial Performance - A Study of APTDC Syed Khaja Safiuddin 154-166
- Incremental Innovation – Indian IPR Policy Issue V.V.Sople and Vishal Dakhole 167-178

### Book Reviews

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## Portfolio Risk and Return Relationship – An Empirical Study

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*The present study attempts to analyze the portfolio performance of Nifty stocks during the study period and to measure the total risk. For the purpose of analysis, the daily, weekly and monthly closing prices of NSE Nifty listed companies, for the period from April 2004 to 2009, have been identified. The study found that there was a high positive correlation between portfolio returns and risk. It also reveals that the portfolio unsystematic risk declined due to diversification. The study is useful to understand the impact of systematic and unsystematic risk through portfolio construction.*

*Keywords: Systematic Risk, Unsystematic Risk and Time Series Regression*

### Introduction

The risk and returns analysis is the basis of making an investment decision. Such investment decision could provide better returns. But the expectation of returns may not materialize because of a number of reasons. The chance of not getting the expected or targeted returns is called Risk. The variation in investors' expectations to tangible and intangible factors of each stock can cause change in its value which is called unsystematic risk. The modern portfolio theory asserts that the risk of investment can be reduced significantly by clubbing together a number of risky assets, which is known as Diversification. Diversification is the strategy of combining distinct asset classes in a portfolio in order to reduce overall portfolio risk. In other words, diversification is the process of selecting the asset mix so as to reduce the uncertainty in the returns of portfolios. Diversification helps to reduce risk when one uses different investment avenues. Hence, in this article an attempt has been made to analyse the portfolio performance consisting of Nifty Stocks and to measure systematic and unsystematic risk.

### Review of Literature

Different studies, examining the risk and returns relationship and construction of portfolio, have been reviewed to understand the research gap and methodology adopted by earlier researchers.

In their study entitled, "On the Number of Securities which Constitute an Efficient Portfolio", Nakasato

and Koichi (1993) discussed the relationship between the number of securities which constituted an efficient portfolio as defined by the standard mean variance portfolio selection model. The authors have proposed the long period of investment to compute the efficient portfolio returns.

In his study "Risk and Return: A New Look at the Indian Stock Market", Madhusoodanan (1997) analyzed the relationship between risk and returns and tested whether there was positive returns in the Indian stock market. But the study found that there were no positive returns in short period along with risks in the market. So it is suggested that the investors may invest their money for a period more than a year in the Indian Stock Market. Otherwise they lose their money because higher risk does not result in high returns.

Gurumoorthy and Amilan (2003), in their study entitled, "Beta and Stock Returns in India", found that the beta can be used as an indicator of future returns of equity shares. They selected a random sample of 30 specified group of shares listed in BSE and beta values were calculated for the selected sample. The beta was arranged in an ascending order and scrips were grouped into three portfolios i.e. low, medium and high beta portfolios. In the portfolio, the future return was calculated by using risk adjusted returns. The study revealed that many factors affected the market returns.

A study entitled, "Risk-Return Relationship and Effect of Diversification on Non-Market Risk: Application



of Market Index Model in Indian Stock Market” by Raj S. Dinakar and Rakesh Kumar (2006), attempted to measure the relationship between risk and returns and the effect of diversification on non-market risk in Indian Market by applying Market Index Model. The authors analyzed monthly adjusted opening and closing prices of composite portfolio of BSE 100 companies. The study concluded that Indian Stock Market offered increasing returns to those investors who invested in high risk portfolio.

“An Empirical Testing of Risk Factors in the Returns on Indian Capital Market”, by Manjunatha and Mallikarjunappa (2006) revealed that CAPM is useful to understand the complex relationship between the returns and risk of securities. It is found that the intercept of the CAPM is equal to the risk-free rate of returns but none of univariate variables, taken individually, explained the portfolio returns in the Indian Market. The beta is a significant explanatory variable for percentage returns when portfolio is constructed with market value. The study concluded that CAPM was the most popular model to find out the excess return in the Indian stock market.

An article entitled, “Risk>Returns Analysis of Private and Public Mutual Funds” done by Lenin Kumar and Rama Devi (2010) analysed the performance of selected mutual funds by using Average Rate of Returns, Standard Deviation and Co-efficient of Variance. The study found that there is no significance difference between the returns of Private Sector Mutual Funds and Public Sector Mutual Funds during the study period.

From the earlier research studies, it has been found that the researchers have examined the risk and returns relationship and the effect of diversification on the portfolio risk by using CAPM. The results of those earlier studies clearly supported the relationship between risk and returns in the long term period i.e. more than one year and the diversification of portfolio unsystematic risk. An attempt has been made in this study to test the findings of the earlier studies in the changed environment.

### Statement of the Problem

An efficient capital market provides higher returns for higher risk. But the variability of stock returns is the result of systematic and unsystematic risk.

The proportionate level of unsystematic risk is high. The investors face the problem of diversifying the unsystematic risk from their investment. In this scenario, it becomes necessary to study the above problems which would help the investors in their portfolio construction. The earlier studies were conducted to examine the risk and returns relationship in the short period and they constructed a portfolio with large number of securities. Further, the effects of diversification on the portfolio risk using CAPM for the BSE listed stocks were studied. No comprehensive study was carried out to analyze the portfolio risk and returns relationship in the long term. Hence, the present study attempts to analyze the portfolio risk and returns relationship and to examine the impact of systematic and unsystematic risk factors for the NSE Nifty Stocks.

### Need for the Study

The empirical evidence shows that the Indian Stock Market has semi-strong efficiency. Many researchers have examined the risk and returns relationship and the effect of diversification on the portfolio risk for different time periods in the Indian Stock Exchanges. Those studies tested the beta by using the realized returns. But the present study aims at testing whether there is any positive relationship between risk and returns during the long term period in the Indian stock market. Further, this study empirically tests whether portfolio construction is useful to diversify unsystematic risk in the changed scenario of Indian Capital Market with particular reference to NSE.

### Objectives of the Study

The following are the major objectives of this study.

- (i) To ascertain the relationship between portfolio returns and portfolio beta.
- (i) To analyse the impact of the systematic and unsystematic risk on portfolio returns.

### Hypotheses of the Study

As stated earlier, the main objective of this study is to test the relationship between portfolio risk and returns and the impact of systematic and unsystematic risk on portfolio returns. Accordingly, the following two hypotheses were tested.



H01: There is no significant relationship between portfolio returns and portfolio beta.

H02: There is no significant impact of systematic and unsystematic risk on portfolio returns.

### Methodology of the Study

#### (a) Sample Size

The present study attempts to test the relationship between portfolio risk and return. Equal weights were assigned to each security

in the construction of portfolio. The sample companies were taken from Nifty of National Stock Exchange. After perusal, out of 50 companies, only 40 companies which actively traded in the NSE from April 2004 to March 2009, were selected. The list of the sample companies is given in Table 1. The daily, weekly and monthly adjusted share prices of sample companies were taken into account for this study. S&P CNX NIFTY Index of NSE were used as a benchmark for this study.

**Table 1: List of Sample Companies (frequently traded firms)**

Sl.No	Name of the Company	Sl.No	Name of the Company
1	A B B Ltd.	21	Larsen & Turbo Ltd.
2	A C C Ltd.	22	Mahindra & Mahindra Ltd.
3	Ambuja Cements Ltd.	23	Maruti Suzuki India Ltd
4	Axis Bank	24	National Aluminium Co. Ltd.
5	Bharath Heavy Electricals Ltd	25	Oil & Natural Gas Corpn. Ltd.
6	Bharath Petroleum Corporation Ltd.	26	Punjab National Bank
7	Bharti Airtel Ltd	27	Ranbaxy Laboratories Ltd.
8	Cipla Ltd	28	Reliance Capital Ltd.
9	GAIL (India) Ltd.	29	Reliance Industries Ltd.
10	Grasim Industries Ltd.	30	Reliance Infrastructure Ltd
11	HCL Technologies Ltd.	31	Siemens Ltd.
12	HDFC Bank Ltd.	32	State Bank of India
13	Hero Honda Motors Ltd.	33	Steel Authority of India Ltd.
14	Hindalco Industries Ltd	34	Sun Pharmaceutical Inds. Ltd.
15	Hindustan Unilever Ltd	35	Tata Communications Ltd.
16	HDFC Ltd.	36	Tata Motors Ltd.
17	ICICI Bank Ltd.	37	Tata Power Co. Ltd.
18	ITC Ltd.	38	Tata Steel Ltd.
19	Infosys Technologies Ltd.	39	Unitech Ltd.
20	Jindal Steel & Power Ltd	40	Wipro Ltd.

Source: Prowess Corporate Database

**b) Period of the Study**

The present study used the data of daily, weekly and monthly- adjusted opening and closing prices of sample stocks traded for the period of five years from 01.04.2004 to 31.03.2009.

**c) Sources of Data**

The present study mainly depends on secondary data. The data regarding adjusted opening and closing share prices and nifty index were obtained from PROWESS corporate data base. The other relevant information was obtained from books, journals and various web sites.

**d) Tools Used for Analysis**

The following tools were used for the present study.

i. The stock returns and market returns were calculated with the help of the following

$$\text{formula: } R_m = \frac{\text{index}_t - \text{index}_{t-1}}{\text{index}_{t-1}} \times 100 \quad \text{---1.0}$$

$$R_i = \frac{P_t - P_{t-1}}{P_{t-1}} \times 100 \quad \text{---1.1}$$

Where,

$R_m$  = Market returns

$R_i$  = Stock returns

$P_t$  = Closing Price of the stock

$P_{t-1}$  = Opening Price of the stock

ii. The risk measures like market beta ( $\beta$ ) for each selected stock were calculated with the help of time series regression analysis, using the following equation:

$$E(R_i) = \alpha_i + \beta_i R_m + e_i \quad \text{---1.2}$$

Where,

$E(R_i)$  = Expected returns on i asset

$\alpha_i$  = Intercept of Security i

$R_m$  = The rate of return on market index

$\beta_i$  = Slope of the Security i

$e_i$  = the random error term

iii. Based on the market beta, the selected securities under Nifty were grouped into eight portfolios of five stocks each, after arranging securities in an ascending order based on market betas. The beta for each portfolio was calculated as follows.

$$\beta_p = \sum_{i=1}^n x_i \beta_i \quad \text{---1.3}$$

Where,

$i$  = 1, 2, 3, 4, 5

$x_i$  = 0.2

$\beta_p$  = Beta on the portfolio

iv. Total risk of a security is the sum of total systematic risk and total unsystematic risk. Symbolically, it is written as:

$$\sigma_i^2 = \beta_i^2 \sigma_{x_i}^2 + e_{it}^2 \quad \text{---1.4}$$

Where

$\sigma_i^2$  - Variance of Stock i representing Total risk

$\beta_i^2 \sigma_{x_i}^2$  - Systematic Risk

$e_{it}^2$  - Unsystematic Risk

v. The portfolio returns were measured by assigning equal weights to each security in the portfolio. The expected portfolio returns can be calculated by using the following formula.

$$E(R_p) = \sum_{i=1}^N w_i (\alpha_i + \beta_i \chi) \quad \text{---1.5}$$

Where

$E(R_p)$  - expected returns on portfolio

$w_i$  - weighted average

$\alpha_i$  - intercept

$\beta_i \chi$  - slope



## Analysis of the Study

### a) Analysis of the relationship between Portfolio Returns and Portfolio Risk

Table 2 presents portfolio beta, portfolio beta t value and expected returns on portfolio for daily, weekly and monthly share price data. From the table, it can be observed that betas are highly significant at 5 percent level for all portfolios. It presents the statistical summary of the daily, weekly and monthly portfolio risk and returns of NSE Nifty companies. It also provides the information relating to expected returns on portfolio values. As stated earlier, all the 40 sample companies were arranged in the ascending order on the basis of its beta value. Then portfolio is constructed by taking the stock of five companies in each portfolio i.e. eight portfolios. It is to be noted that all the portfolios arranged in the ascending order were statistically significant at 5% level.

The analysis of Table 2 clearly reveals the fact that in daily portfolio analysis, the portfolio risk has increased from 0.57 in Portfolio 1 to 1.43 in Portfolio 8. The returns also increased from 0.42 to 1.05 proportionate to the risk. The portfolio risk and returns values of Portfolio 5 to Portfolio 8 were higher than the average portfolio daily value (0.71). It shows that those

portfolios performed better than other portfolios while analyzing daily returns.

The weekly risk and returns increased respectively from 0.53 ( $\beta_p$ ) and 0.37 ( $E(R_p)$ ) in Portfolio 1 to 1.54 ( $\beta_p$ ) and 1.1 ( $E(R_p)$ ) in Portfolio 8. However, the returns values of weekly Portfolio 5 ( $E(R_p)$  0.76) to Portfolio 8 ( $E(R_p)$  1.1) were higher than the average Portfolio values ( $E(R_p)$  0.74).

With reference to monthly portfolio analysis, 0.48 ( $\beta_p$ ) and 0.35 ( $E(R_p)$ ) were the monthly risk and returns for Portfolio 1. However, 1.69 ( $\beta_p$ ) was the monthly risk and 1.26 ( $E(R_p)$ ) was the monthly returns for Portfolio 8. This indicates the fact that the portfolio with high beta value is termed as high risk returns class and portfolio with low beta value is termed as low risk returns class. It is clear from the overall analysis of share price performance, the monthly average portfolio earned higher risk ( $\beta_p$  1.06) and returns ( $E(R_p)$  0.78) than daily and weekly portfolios. It shows that the Nifty stocks performed well during the long period. Thus the null hypothesis -H01, "There is no significant relationship between portfolio returns and portfolio beta", is rejected.

**Table 2: Analysis of the relationship between portfolio return and portfolio beta**

Portfolio	Stock	Daily			Weekly			Monthly		
		Bp	$t_\beta$	$E(R_p)$	Bp	$t_\beta$	$E(R_p)$	Bp	$t_\beta$	$E(R_p)$
P1	5	0.57*	17.16	0.42	0.53	6.68	0.37	0.48	3.07	0.35
P2	5	0.72*	17.31	0.53	0.81	9.86	0.57	0.79	6.02	0.58
P3	5	0.86*	26.59	0.63	0.91	10.31	0.64	0.86	5.37	0.63
P4	5	0.96*	29.24	0.70	0.97	12.01	0.69	0.98	6.85	0.73
P5	5	1.02*	25.42	0.75	1.07	14.93	0.76	1.1	7.30	0.81
P6	5	1.06*	31.77	0.78	1.15	14.60	0.82	1.21	8.84	0.89
P7	5	1.15*	31.98	0.84	1.32	14.36	0.94	1.38	7.71	1.01
P8	5	1.43*	36.18	1.05	1.54	14.65	1.1	1.69	6.77	1.26
Average		0.97	26.96	0.71	1.04	12.18	0.74	1.06	6.49	0.78

Source: Computed from PROWESS DATABASE

Note: Bp- Portfolio Beta,  $t_\beta$  - Portfolio beta t value,  $E(R_p)$  - Expected returns on Portfolio

\* Significant at 5% level



### b) Impact of Systematic and Unsystematic Risk on Portfolio Return

The summary of daily, weekly and monthly portfolio's total risk, systematic risk and unsystematic risk is given in Table 3. The total daily risk of portfolio increased from 6.52 for portfolio 1 and 14.71 for portfolio 8. The total risk includes the systematic risk ( $\beta^2 \sigma_x^2$ ) and unsystematic risk ( $e_r^2$ ) of portfolio. The analysis of systematic risk showed that the portfolio consisting of low beta value has earned low market risk and high beta value portfolio has earned high market risk. In the case of unsystematic risk, the results were fluctuating during the study period. With reference to weekly and monthly portfolio analysis, the total risk of Portfolio 1 increased from 32.41 to 96.89 ( $Pt_{var}$ ) and for Portfolio 8 from 146.20 to 597.97 ( $Pt_{var}$ ).

The analysis of systematic risks in respect of daily, weekly and monthly portfolios shows an increasing trend from Portfolio 1 to Portfolio 8 i.e., from 1.19 to 7.32, from 4.14 to 33.93, from 17.94 to 214.15.

The results of weekly and monthly unsystematic risk results were also fluctuating. The declining value of ( $1-R^2$ ) with successive portfolio in monthly portfolio construction clearly indicates that unsystematic risk declined with

diversification in Portfolio 1 (0.85) to Portfolio 8 (0.57) compared to the average value (0.60). The ( $1-R^2$ ) values for Portfolio 4, Portfolio 6 and Portfolio 7 were 0.60, 0.55 and 0.57 which indicate fluctuating trend in the case of daily portfolio analysis. The weekly portfolio analysis also has the fluctuating trend with the ( $1-R^2$ ) values of 0.44, 0.56, 0.43 for Portfolio 4, Portfolio 6 and Portfolio 8 respectively. It depicts the fact that the possibility of diversification of unsystematic risk in the long period (monthly) is very high.

The correlation coefficient between portfolio total systematic risk ( $\beta^2 \sigma_x^2$ ) and portfolio expected returns E (Rp), and between portfolios beta (Bp) and portfolio expected returns E(Rp) were 0.98 and 0.99 for daily, weekly and monthly portfolio analysis. It signifies the fact that there was high positive and linear relationship at 5% level of significance. This is due to the fact that the portfolio constructed with large number of stocks moves in accordance with the market movement. The rate of returns of a portfolio with well diversified unsystematic risk in long term is highly correlated with the market as a whole. Hence, the null hypothesis, "H02: There is no significant impact of systematic and unsystematic risk on portfolio return" is rejected.

**Table 3: Impact of Systematic and Unsystematic Risk on Portfolio Return**

Portfolio	Daily					Weekly					Monthly				
	$Pt_{var}$	$\beta_i^2 \sigma_{x_i}^2$	$e_r^2$	$R^2$	$1-R^2$	$Pt_{var}$	$\beta_i^2 \sigma_{x_i}^2$	$e_r^2$	$R^2$	$1-R^2$	$Pt_{var}$	$\beta_i^2 \sigma_{x_i}^2$	$e_r^2$	$R^2$	$1-R^2$
P1	6.52	1.19	5.33	0.19	0.81	32.4	4.14	28.26	0.15	0.85	146.20	17.94	128.26	0.15	0.85
P2	10.7	1.87	8.84	0.20	0.81	40.1	9.42	30.65	0.38	0.62	129.15	46.25	82.90	0.37	0.63
P3	7.8	2.66	5.14	0.36	0.64	46.8	11.70	35.08	0.32	0.68	202.92	55.31	147.60	0.31	0.69
P4	8.39	3.27	5.13	0.40	0.60	40.7	13.25	27.45	0.44	0.56	163.41	71.21	92.20	0.44	0.56
P5	11.6	3.73	7.88	0.34	0.66	36.7	16.30	20.44	0.49	0.51	189.03	89.80	99.22	0.48	0.52
P6	9.78	4.01	5.77	0.45	0.55	36.2	18.92	24.30	0.56	0.44	192.57	108.35	84.22	0.56	0.44
P7	14.00	4.73	9.27	0.43	0.57	59.1	25.23	33.82	0.49	0.51	291.28	139.83	151.44	0.49	0.51
P8	14.7	7.32	7.4	0.51	0.49	96.9	33.93	62.96	0.43	0.57	597.97	214.15	383.82	0.43	0.57
Average	10.4	3.59	6.84	0.36	0.63	48.6	16.61	32.87	0.41	0.59	239.07	92.86	146.21	0.40	0.60

Source: Computed from PROWESS DATABASE

Note:  $Pt_{var}$  - Portfolio variance,  $\beta_i^2 \sigma_{x_i}^2$  - Aggregate systematic risk of the portfolio,  $e_r^2$  - Unsystematic risk,  $R^2$  - Variation of portfolio returns which is explained by market returns,  $1-R^2$  - Variation in portfolio returns which is not explained by market returns.



## Findings of the Study

The following are the findings of the study:

- (i) The significant correlation coefficient between portfolio systematic risk and portfolio expected returns exhibits a linear and positive relationship.
- (ii) Similarly the significant correlation coefficient between portfolio expected returns and portfolio beta exhibits a linear and positive relationship.
- (iii) The sample stocks with high beta values have given high returns to the investors during the study period. Similar relationship is also observed for portfolio market risk and expected returns.
- (iv) As the investors move from low market risk portfolio to high market risk portfolio, their exposure to unsystematic risk was reduced in the long term investment i.e. for a month.
- (v) The study found that the Indian stock market responds efficiently with longer time horizon for holding the stocks.
- (vi) The investors get moderately high returns by holding risky portfolios on weekly basis. But their returns are maximized by holding high risky portfolios for a month.
- (vii) It is found that there is a significant relationship between risk and returns on daily and weekly portfolio analysis. The relationship between monthly portfolio expected returns and risk is more positive than daily and weekly portfolio expected returns and risk. This tendency of the stock market signifies the fact that the investors gradually readjust their holdings of stocks in response to systematic risk and unsystematic risk.

## Conclusion

The present study is an attempt to determine the portfolio risk and return relationship and the impact of systematic and unsystematic risk on portfolio return. It is found that moderately high returns are available by getting risky portfolios on a weekly basis. However, the returns are maximized by risky portfolios for a

month. Finally, this study concludes that when the investors invest their stocks in the long time horizon, they get high risk and high returns during the time period with efficiently diversified unsystematic risk.

## Scope for Future Research

- The present study was carried out by using the CAPM Market Model in Nifty index companies. It may be applied to the indices of other stock exchanges in India and worldwide.
- There is a possibility of adding more non-market factors like inflation, interest rate, foreign exchange rate, purchase power parity, etc. and test the portfolio performance.
- Further, the studies may be extended by employing advance models like ARCH, GARCH, etc. to construct the portfolio for different time periods.

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