



Impact of COVID-19 on Indian Stock Market – using Sharpe’s Single Index Model

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Abstract

The immense challenge of Covid-19 extends across all sectors of the global economy. COVID-19 quickly spread all over the world and dramatically affected the financial markets in almost every country. Its spread created havoc in the market, and investors fearing risk suffered a significant amount of financial loss in a very short time. Many countries imposed strict lockdowns to contain the further spread of the virus and halted all major economic operations, which ultimately were received negatively by stock markets, hence the inevitable market crash in March 2020. Stocks generally react to events that may be perceived either positively or negatively by investors and traders, depending on the type of event. The volatility of stock market stops many from taking risks of investing in shares. Every investment avenue is associated with varying degrees of risk. So, an intelligent investor would like to diversify his risk in many securities. Construction of portfolio helps to diversify the risk. Among the models available for portfolio construction Sharpe’s Single Index Model helps the investor to make right choices of securities. The present study aims to construct the optimal portfolio by using Sharpe’s Single Index Model with selected stocks from NSE. Basically it can be done by ranking the selected securities based on excess return to beta ratio and finding out the optimal combination of the securities with respect to the cutoff point (C_i).

Keywords: Beta, Cutoff point, Volatility, rational investor, investment avenues, Sharpe’ Single Index Model, NSE.

JEL Classification: G11

Introduction

The rapid spread of the unprecedented COVID-19 pandemic has put the world in jeopardy and changed the global outlook unexpectedly. The virus that caused the COVID-19 outbreak initially in Wuhan city, China in December 2019, spread all over the globe. This resulted not only in a global health emergency, but in a global economic downturn too. As many countries adopted strict quarantine policies to fight the unseen pandemic, it resulted in shutting down their major economic activities. The impact is felt on the investors as they are suffering huge losses on their investment in general, and on stocks in particular. Stocks generally react to events that may be perceived either positively or negatively by investors and traders, depending on the type of event. The volatility of stock market stops many from taking risks of investing in shares. Every investment avenue is associated with varying degrees of risk. So, an intelligent investor would like to diversify his risk in many securities. The primary objective of an investor is to earn maximum return with minimum risk. By constructing an optimal portfolio the risk can be diversified. Among the various models available for portfolio

construction, Sharpe's Single Index Model helps the investor to make right choices of securities. Hence, the same is applied to know the impact of Covid 19 on Indian stock market.

Review of Literature

The results of few studies in the chosen area are presented below briefly:

- **Saurabh Singh and JayantGautam (2014)** : “The Single Index Model & the Construction of Optimal Portfolio: A Case of Banks Listed on NSE India” was studied and found that only two out of ten companies were available for investment purpose as per the Sharpe's model.
- **Tanu Nandan and Nivedita Srivastava (2017)**: “Construction of Optimal Portfolio Using Sharpe's Single Index Model: An Empirical Study on Nifty 50 Stocks” was studied and found that majority of the stocks in the optimal portfolio were from the banking sector indicating that stocks of financial sector provide consistent and assured returns.
- **Seema Shokeen (2017)**: “Application of the Sharpe's Single Index Model for Optimal Portfolio Construction” was studied using monthly share prices of selected 15 companies from the BSE and found that only five out of fifteen listed companies were available for portfolio construction using the Sharpe's Model.
- **Murthy's (2018)**: “The Construction of Optimal Portfolio Using Sharpe's Single Index Model - An Empirical Study on Nifty Metal Index” was studied using 14 metal stocks revealed that only two stocks constitute the optimum portfolio, namely Vedanta and Tata Steel, respectively.
- **Sulistyo Adi Nugroho et al.,(2021)**: “Portfolio Analysis using the Single Index Method in the COVID-19 Pandemic Period” with share prices of five sectors were studied. The Sharpe's, Treynor and Jensen indices were positive, which indicated that portfolios formed using a Single index model had the potential fetch good returns on investment.
- **Immas Nurhayati, Endri Endri et al., (2021)**: “The impact of COVID-19 on formation and evaluation of portfolio performance: A case of Indonesia” using Sharpe's Model was studied. The sample included firms listed on IDX sorted by capitalization. The study concluded that the average difference in market returns before and after COVID-19 was not significant.

Objectives

- To measure the Holding Period Returns of the selected stocks during pre COVID-19 and post COVID-19.
- To find the expected returns of the selected stocks during pre COVID-19 and post COVID-19 period, using CAPM Model; and
- To construct an optimal portfolio to study the impact of COVID-19 on stock prices of selected sectors in NSE for both the periods.

Scope of the study

The study is limited to know the impact of COVID-19 on the selected stocks of NSE for constructing of an optimal portfolio. The returns during the pre and post COVID-19 were calculated. The study period is from 24th March 2018 to 24th March 2022 on a daily basis.

Methodology

The study is empirical in nature and secondary data was used for the study. Data from official website of NSE was used for the study. Holding Period Return and CAPM model were used for evaluating the returns of the stocks for the period from 24th March 2018 to 24th March 2022 on daily basis. Sharpe's Single Index Model is

used for optimal portfolio construction for both pre and post COVID-19 periods to know the changes in stocks included in the optimal portfolio constructed.

Methods and tools for analysis

a) Holding Period Return (HPR)

HPR is calculated as under:

$$\text{Holding Period Return} = (\text{End of Period Value} - \text{Initial Value}) / \text{Initial Value} * 100$$

b) Capital Asset Pricing Model (CAPM)

Formula used for calculating the expected returns is:

$$\text{CAPM} = R_f + \beta (R_m - R_f)$$

c) Sharpe's Single Index Model (SIM)

According to SIM, the stocks to be included in optimal portfolio are determined on the basis of their 'Excess return to beta ratio'. Here, ranking of stocks is made based on "highest excess return to beta ratio". Highest ratio will be placed in the first position, followed by the security with second highest beta ratio, and so on. Cut-off point is calculated and finally proportion of investment will be calculated. Thus, an investor can easily take a decision as to how much to invest in each of the stocks.

Various formulae used are as follows;

- Calculation of excess return to beta is given by $(R_i - R_f) / \beta$
Where R_f = Risk free rate of interest (5 years bond yield)
- Cut off rate (C_i) is calculated for all the securities using the formula

$$C_i = \frac{(\sigma^2 \sum (R_i - R_f) \beta / \sigma^2 \epsilon_i)}{1 + \sigma^2 \sum \beta_i^2 / \sigma^2 \epsilon_i}$$

- The proportion of each stock to be invested in portfolio is calculated using the formula

$$W_i = Z_i / \sum Z_i$$

Where

$$Z_i = \beta_i^2 / \sigma^2 \epsilon_i \{ ((R_i - R_f) / \beta) - C^* \}$$

Data Analysis and Interpretation

Top ten companies listed under NSE Nifty Fifty have been selected for the study based on the market capitalization. The selected companies belong to various sectors. The Holding Period of Return and CAPM models were used for determining the returns of selected stocks from 24th March 2018 to 24th March 2022. The period was divided into two as pre (from 24th March 2018 to 23rd March 2020) and post (from 24th March 2020 to 24th March 2022) COVID-19 period. Sharpe's Single Index Model was applied for optimal portfolio construction in order to study the impact of COVID-19 on stock prices of selected sectors in NSE Nifty during the pre and post COVID-19 period. The change in stocks arrived in optimal portfolio is implied to reflect the impact of Covid 19. MS Excel was used for calculation and analysis purposes. The results are tabulated below:

Table – 1: Sample Companies & their Market Capitalization

Sl No.	Company Name	Market Capitalization (Rs in Cr)
1	Reliance Industries Ltd (RIL)	1,866,078.98
2	Tata Consultancy Services Ltd (TCS)	1,322,193.30
3	HDFC Bank Ltd	751,884.80
4	Infosys Ltd	666,957.38
5	ICICI Bank Ltd	519,597.53
6	Hindustan Unilever Ltd (HUL)	499,746.31
7	Adani Green Energy Ltd (AGE)	450,874.04
8	State Bank of India Ltd (SBI)	446,766.05
9	Bajaj Finance Ltd	430,505.59
10	Bharti Airtel Ltd	412,968.58

Table -1 shows the list of top 10 companies selected based on the market capitalization for the present study from www.moneycontrol.com and yahoo finance.com.

Following table shows returns from selected stocks

Table-2: Stock Returns during Pre and Post Covid 19

Sl.No	Stock	Pre COVID-19		Post COVID-19	
		Mean Returns (%)	CAPM Returns (%)	Mean Returns (%)	CAPM Returns (%)
1	RIL	7.2195	-19.8957	136.579	68.5678
2	TCS	19.7098	-6.4339	86.4305	46.6805
3	HDFC	-8.7221	-13.1648	56.7948	60.6200
4	Infosys	-1.1251	-8.9870	143.8385	86.2950
5	ICICI	11.7739	-21.9846	115.1275	126.1733
6	HUL	36.8568	-8.7549	2.6627	48.6441
7	AGE	44.5513	4.0106	50.01	13.0810
8	SBI	-7.9860	-24.3056	120.4418	86.5402
9	Bajaj	41.4230	-27.5550	140.2253	120.1116
10	Bharti	1.6062	-13.3969	63.5671	68.7156

Table 2 shows that during the pre COVID-19 period the realized mean return of Adani Green Energy Ltd is the highest (44.5513) while HDFC Bank Ltd's is the lowest (-8.7221). Adani Green Energy Ltd has the highest expected return (4.0106) as per the CAPM model whereas Bajaj Finance Ltd has the lowest expected return (-27.5550). In the post COVID-19 period, Infosys Ltd has the highest realized mean return (143.8385) whereas Hindustan Unilever Ltd has lowest realized return (2.6627). ICICI Bank Ltd has the highest return (126.1733) as per the CAPM Model and Adani Green Energy Ltd has the lowest return (13.0810).

Construction of Optimal Portfolio Using Sharpe's single Index Model

A. Optimal Portfolio- Pre COVID-19

Table-3: Excess Return to Beta Ratio

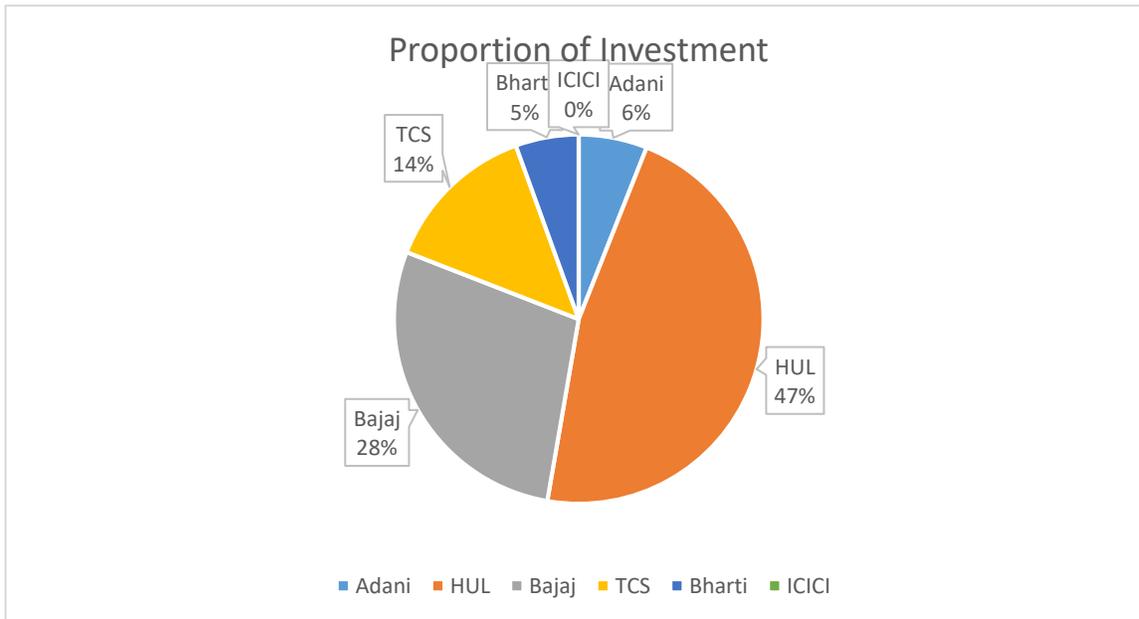
SI No	Security Name	R _i	B	σ^2_{ei}	(R _i -R _f /β)	Rank
1	RIL	7.2195	1.17	2.0432	-0.0346	7
2	TCS	19.7028	0.59	2.3490	21.1014	4
3	HDFC	-8.7221	0.88	0.9493	-18.1615	10
4	Infosys	-1.1251	0.70	2.7283	-11.9787	9
5	ICICI	11.7739	1.26	2.5510	3.5825	6
6	HUL	36.8568	0.69	1.6407	42.8939	2
7	AGE	44.5513	0.14	16.2732	266.3664	1
8	SBI	-7.9860	1.36	2.9785	-11.2103	8
9	Bajaj	41.4230	1.50	3.1059	22.7753	3
10	Bharti	16.6060	0.89	4.2165	10.5014	5

Above table shows the mean return of stocks, sensitivity index (beta), and excess return to beta ratio. R_f is the risk free rate of return of 10 years bond yield (7.26%), R_m (-15.9519) is the market return (Nifty 50) and σ^2_m is the Market variance (5.9825%). Excess return to beta ratio is used to rank the securities from highest to lowest and stocks with highest excess return to beta ratio occupies the first position followed by the second position and so on. Adani Green Energy Ltd (266.3664) occupies the first place among 10 companies and HDFC Bank Ltd (-18.1615) is ranked the last due to its negative returns. Stocks of Reliance Industries Ltd., HDFC Bank Ltd., Infosys Ltd. and State Bank of India Ltd., have negative returns and so these companies are not considered for selection of portfolio as per this model. Thus, only six companies are available for construction of optimal portfolio. Table 3 also shows that the Adani Green Energy Ltd is ranked the first while HDFC Bank Ltd occupies last rank according to the excess return to beta ratio value. C_i indicates that the cut-off rate and C^* indicates cut-off point from the cut-off rates. C_i values shows the values in increasing order and at the point 0.6107 (ICICI Bank Ltd) is the highest cut-off point.

Table-4: Proportion of Investment

SI No	Security Name	β/σ^2_{ei}	(R _i -R _f /β)	Z _i	Investment proportion (X _i)
1	AGE	0.0086	266.364	2.2872	0.0574
2	HUL	0.4205	42.8939	17.8269	0.4471
3	Bajaj	0.4830	22.7753	10.7561	0.2698
4	TCS	0.2512	21.1014	5.1735	0.1297
5	Bharti	0.2112	10.5014	2.1102	0.0529
6	ICICI	0.5587	3.5825	1.7201	0.0431

Table- 4 shows the proportion to be invested in six selected stocks in the optimal portfolio. The proportion of amount to be invested in each stock gives a fair idea to the investor. It describes the allocation of funds for various stocks to get the maximum benefits of the optimal portfolio.

Chart-1

Above Pie chart shows the investment proportion of 6 stocks. Hindustan Unilever Ltd has got the highest proportion (47%), Bajaj Finance Ltd followed by (28%) of proportion and the least proportion of investment is in ICICI Bank Ltd (4.31%). Thus, the Sharpe's Single Index Model resolves the problems involved in the selection of securities to construct a portfolio of an investor.

B. Optimal Portfolio- Post COVID-19

Table-5: Excess Return to Beta

Sl No	Security Name	Ri	β	σ^2_{ei}	$(R_i - R_f / \beta)$	Rank
1	RIL	136.579	0.79	3.4355	163.7157	2
2	TCS	86.4305	0.51	2.2827	155.8781	3
3	HDFC	5.7948	0.69	2.8513	72.0506	7
4	Infosys	143.8385	1.02	1.3423	134.1240	4
5	ICICI	115.1275	1.53	2.3551	70.4050	9
6	HUL	2.6627	0.53	1.9989	-8.6221	10
7	AGE	50.01	0.08	8.4547	570	1
8	SBI	120.4418	1.12	3.2503	101.5083	5
9	Bajaj	140.2243	1.45	4.2848	91.4479	6
10	Bharti	63.5671	0.79	3.5029	71.1128	8

Table 5 shows the mean return of stocks, sensitivity index (beta), and excess return to beta ratio. R_f is the risk free rate of return of 10 years bond yield (7.26%), R_m (84.8746%) is the market return (Nifty 50) and σ^2_{m} the Market variance (6.4018%). Table 5 also shows that ICICI Bank Ltd has the highest cut-off point. Except HUL all the companies are included in the optimal portfolio.

Table-6: Investment Proportion

Sl No	Security Name	β / σ^2_{ei}	$(R_i - R_f / \beta)$	Zi	Investment proportion (Xi)
1	AGE	0.0089	570	5.0092	0.0163
2	RIL	0.2299	163.7157	36.4200	0.1182
3	TCS	0.2225	155.8781	33.4999	0.1087

4	Infosys	0.7586	134.124	97.7168	0.3172
5	SBI	0.3430	101.5083	32.9986	0.1071
6	Bajaj	0.3393	91.4479	29.2281	0.0948
7	HDFC	0.2411	72.0506	16.0910	0.0522
8	Bharti	0.2260	71.1128	14.8729	0.0483
9	ICICI	0.6506	70.405	42.3439	0.1374

Table- 6 shows the proportion to be invested in various stocks which comprise of the optimal portfolio and the same is shown in the following Pie Chart:

Chart-2

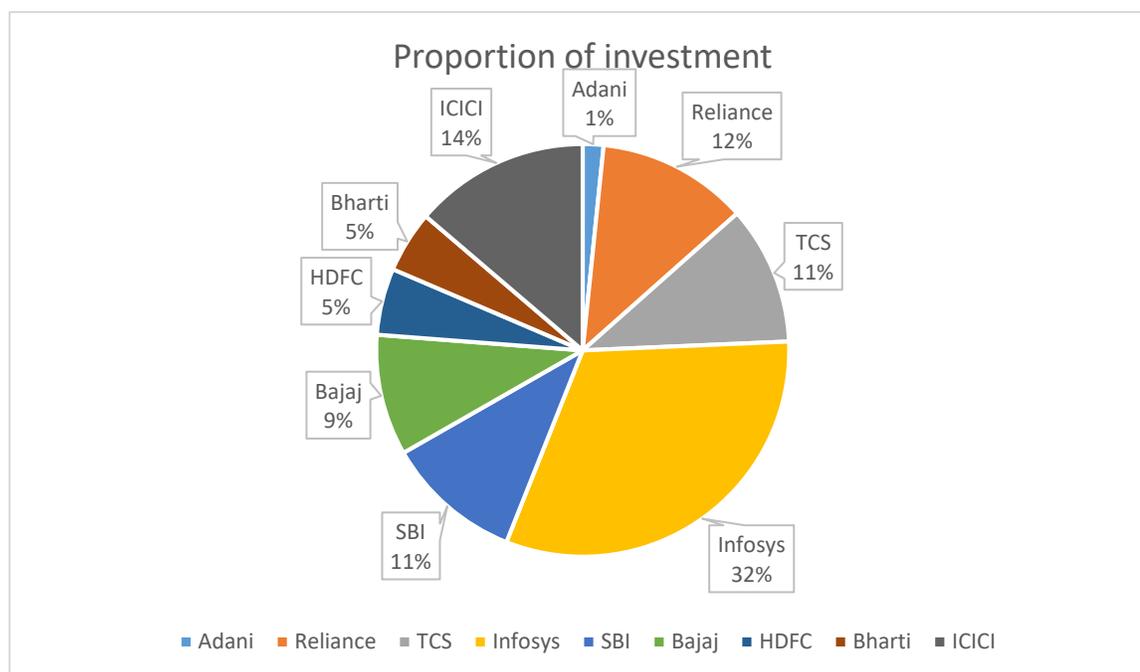


Chart 2 shows the investment proportion of 9 stocks. Infosys Ltd has got the highest proportion (32%) followed by ICICI Bank Ltd in second place (14%) and least proportion in Adani Green Energy Ltd (1%).

Findings and Suggestions

During pre-COVID 19

- It is found that out of 10 stocks considered for the study from Nifty50, only 6 stocks were considered for ranking the securities based on 'excess return to beta ratio' values and also for inclusion in optimal portfolio based on cut-off point of 0.6107.
- Maximum proportion of 47% should be invested in Hindustan Unilever Ltd and least proportion in ICICI Bank Ltd (4.31%).
- The Highest beta is found in Bajaj Finance Ltd (1.50) stock and lowest beta in Adani Green Energy Ltd stock (0.14)
- Majority of the stocks are defensive stocks as their beta is less than 1. Risk averse investors may choose such type of securities to invest in.

During post-COVID-19

- It is found that out of 10 stocks considered for study from Nifty 50, nine stocks were considered for ranking the securities based on 'excess return to beta ratio' values and for inclusion in optimal portfolio based on cut-off point of 5.3160.

- 32% percentage of investment should be made in stock of Infosys Ltd and least proportion in Adani Green Energy Ltd stock (1%).
- Beta of ICICI Bank Ltd stock is the highest (1.53) while the beta of Adani Green Energy Ltd (0.08) is the lowest.
- Stocks with beta more than one and less than one have been obtained in the portfolio. Risk averse investors may choose stock which is less than one and speculators may prefer the stocks with beta more than one.

Conclusion

To conclude, the study shows that there is a significant impact of COVID-19 on Indian stock market based on selected stocks from Nifty 50. Sharpe's Model used to construct optimal portfolio revealed that there is a difference in the stocks included in portfolio during pre and post COVID-19 period. Hindustan Unilever Limited stock is not included in the portfolio constructed during post COVID-19 pandemic.

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