An Empirical Study on Investment and Trading Decision Based on Moving Average Crossover Strategy Applied on Selected Indian Stocks: Pre and during COVID-19

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[Abstract] This empirical research compares the profitability of 13 companies belonging to 13 sectors of the Nifty50 indices of the Indian equities market; it utilizes technical analysis, specifically the Moving-Average (MA) crossover approach and compares it to the typical basic buy-and-hold strategy, both before and during COVID-19. Trading conditions like as entry, exit, and holding rules are utilized to assess the performance of the MA crossover approach. For each stock, a total of 36 Buy and 36 Sell combinations were examined, yielding a total of 1296 strategies. Short and long period exponential moving average (EMA) crossover strategies were used to 13 equities from each sector of the Nifty50 indexes, 19 key results have been generated. According to the findings, it is observed that in 61% of the cases, that is 8 stocks out of the 13 selected stocks, different EMA crossover strategies surpass the simple buy and hold with a higher compound annual growth rate (CAGR). This research takes into consideration of daily closing price data for the period 01st January, 2016 to 26th May, 2021 (pre and during COVID-19 period) and separately analyzed for the period 1st February, 2020 to 26th May, 2021 (during the COVID-19 period). Further, in our empirical study, it is found that during the COVID-19 period, EMA crossover strategies surpass the simple buy and hold with a higher CAGR for 12 stocks from our sample.

[Keywords] trading methods, technical analysis, moving-average combination, COVID-19

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Introduction

Individuals participating in the financial market aim to maximize their profit while minimizing related risk in every economy. Many research studies have been undertaken on the equity market using various technical indicators for stock price prediction.

Technical analysis is based on the idea that by using indicators derived from earlier prices, one can forecast the direction of future stock values. One of the most broadly accepted beliefs is that securities prices follow a predictable pattern. As a result, the trend-following approach is the most generally utilized market-timing method, which tries to follow and ride the trend. This method has been used by market practitioners as a market-timing approach for more than a century.

The MA crossover trading method is a trend-following strategy and a favorite instrument for traders, owing to ease of use and recognizing shift of trends in the market. Professionals have been using EMA for timing the market to predict the prices of stocks in order to generate gain by generating above-average returns and higher.

Investors utilize technical analysis to make investment decisions for a variety of reasons. It is quite possible that prices do not always properly represent relevant information. This is a sign of inefficient market information. When the market is not in its strongest state, information inefficiency might arise, allowing investors to earn superfluous return. As a result, various technical trading methods strive to identify price patterns that might be exploited for profit.

The most prominent trend-following tool for judgement the market at appropriate time is the MA

crossover method. The MAs, along with other indicators, have the greatest predictive value in the stock market, matching or exceeding macroeconomic factors (Neely et al., 2014). The use of MAs for timing the market, whether to purchase, hold, or sell, tries to beat the typical buy-and-hold approach.

Review of Literature

The MA approach is a widely used technical analysis (TA) technique. Moving averages are one of the most fundamental and often used technical analysis tools available. Historical prices and volume, according to technical analysts, is crucial and relevant information for forecasting future price changes in the financial market.

In theory, market participants use TA due to quick information of price movement and might be due to insufficient basic knowledge of Fundamental analysis. Traders who use market data outperform those who do not; even if stock returns are largely predictable, investors risk model ambiguity due to a lack of data (Blume et al., 1994).

There are several doubts cast on TA because theoretical studies on efficient market models ignore superfluous returns if trading activity is performed purely on technical analysis (Fama and Blume, 1966) and contests in confirming the efficiency of technical methods (Sullivan et al., 2003). Despite TA's popularity and broad usage by market practitioners, there has also been doubts cast by scholars on the same.

The theory behind the moving average is simple, according to James (1968), a pioneer in the application of moving average, since uptrend or downtrend security price movements can begin when the current security's price climbs above or below the prior level, respectively.

Brock et al. (1992) and Lo et al. (2000) mentioned that several studies examine various technical trading approaches and reach the same conclusion that TA delivers knowledge that is not represented in market price.

Several research papers have presented evidence in support of the MA crossover approach (Brock et al, 1992; LeBaron, 1999). They observed that the MA crossover approach is lucrative and delivers an above-average market return. Further, basic technical methods can give similar returns when equated with investing strategies based on fundamentals (Olszewski, 2001).

Covel (2011) highlights successful huge hedge funds that rely heavily on TA while having little or no market knowledge.

Metghalchi et al. (2012) used the simple moving average, the exponential moving average, and the autoregressive moving average as indicators on 16 European stock markets. Overall, the results back the profitability of moving average methods, and trading using technical analysis can defeat the simple buy-and-hold approach.

Adrian (2015) studied that MA trading rules using a sample of Bucharest Stock Exchange returns depicting the development of the Bucharest Stock Exchange. The study revealed how the dual moving average crossover rule is used and has a significant impact on its profitability.

Certain methodological combinations of components are more likely to give superior outcomes, implying that technical analysis can be leveraged to generate positive abnormal returns.

The frequently utilized price and moving average cross-over trading methods were employed by Papailias and Thomakos (2015). The study is based on nine separate series: the Dow Jones Industrial Average and S&P500 for 80 and 60 years, respectively; six ETFs for more than 10 years; and the Euro and US Dollar exchange rate for more than 10 years. The modified approach beats both the conventional and buy-and-hold strategies across all studied moving averages, according to the study.

Tapa et al. (2016) evaluated and compared the profitability of technical analysis employing a moving average method to a buy-and-hold strategy in the Malaysian market. The original MA crossover strategy beat the traditional basic buy-and-hold strategy, owing to greater return, higher risk-adjusted return, and lower drawdown.

Ferreira et al. (2018) conducted a statistical investigation of the moving average approach and developed a formula for the expected value and variance. As an outcome, they were able to provide an analytic approach for the Sharpe ratio.

In their study, Niroomand et al. (2020) examined two different tactics utilising MA and gold

switching approaches. They had advised employing 50 days MA > 200 days MA trading principles in the moving average method., advocates purchasing the stock if the Moving Average 50 > Moving Average200 and shorting the stock if the Moving Average 50 < Moving Average 200. Coe and Laosethakul (2021) investigated the profitability of using technical indicators, such as the Moving Average, the RSI, and the Stochastic Oscillator, rather than the buy-and-hold approach across 4822 stocks of 39 Asian countries. They discovered that their trading rules, on average, beat the buy-and-hold approach for 66 percent of the 4822 stocks in their portfolio.

Research Objectives

1. To study the efficiency of the MA crossover strategy compared to the passive buy-and-hold strategy
2. To assess which grouping of MA trading rule delivers superlative results.

Research Methodology

For the purpose the research, we analyzed the 13 stocks of the Nifty50 Index. Stocks which we analyzed are comprised of automobile, cement and cement products, construction, consumer goods, fertilisers and pesticides, financial services, IT, metals, oil and gas, pharma, power, services and telecom sectors. We selected the stocks from each sector based on their highest weight in their respective sectors. The Nifty50 Index is comprised of 13 sectors and the weight of each sector and weight of stocks (NSE, 2021), which we analyzed for this research, are summarized in Table 1:

Table 1
Sectors in Nifty50 and Companies Analyzed

Sector	No. of Companies	Weightage	Company analysed	Weightage in Nifty Index (%)
Automobile	6	5.23%	Maruti Suzuki India Ltd	1.36%
Cement & cement products	3	2.59%	UltraTech Cement Ltd	1.15%
Construction	1	2.56%	Larsen & Toubro Ltd.	2.56%
Consumer goods	7	11.10%	Hindustan Unilever Ltd	3.32%
Fertilisers & pesticides	1	0.53%	United Phosphorus Limited	0.53%
Financial services	11	37.81%	HDFC Bank Ltd	9.72%
IT	5	16.53%	Infosys Ltd	7.93%
Metals	4	3.65%	Tata Steel Ltd	1.27%
Oil & gas	4	11.79%	Reliance Industries Ltd.	10.19%
Pharma	4	3.66%	Sun Pharmaceutical Industries Ltd.	1.12%
Power	2	1.66%	Power Grid Corporation of India Ltd.	0.89%
Services	1	0.84%	Adani Port and Special Economic Zone	0.84%
Telecom	1	2.05%	Bharti Airtel Ltd.	2.05%
Grand Total	**50**	**100.00%**		**42.93%**

Source: NSE website, compiled for author's study

The study compares the performance of MA crossover trading rules to passive buy-and-hold rules in order to determine the best results. We used exponential moving averages (EMA) viz.

1,3,5,9,15,20,50,100,200 of price on selected stocks. The main techniques used in this study are the indicator EMA and the leading indicator relative strength indicator (RSI).
The research is based on secondary data sources for the period of 13th March 2015 to 26th May 2021. Because the use of a 200-day exponential moving average necessitates prior data of two hundred days, all estimates are generated from January 1st, 2016, to May 26th, 2021. The Tradingview professional system was used to retrieve daily stock prices, as well as the EMA and RSI values. Because the first COVID-19 case in India was reported on January 30, 2020, the period beginning on February 1, 2020, is deemed to be during the COVID-19 timeframe in our study. A total of 1296 moving average cross over combinations were analyzed for 13 selected stocks of the Nifty 50 Index. The same have been summarized in the Table 2 below:

Table 2
Moving Average Cross over Combinations

Exponential Moving Average	**(Buy, Sell) Rule**							
1	1, 3	1, 5	1, 9	1, 15	1, 20	1, 50	1, 100	1, 200
3		3, 5	3, 9	3, 15	3, 20	3, 50	3, 100	3, 200
5			5, 9	5, 15	5, 20	5, 50	5, 100	5, 200
9				9, 15	9, 20	9, 50	9, 100	9, 200
15					15, 20	15, 50	15, 100	15, 200
20						20, 100	20, 200	20, 50
50							50, 100	50, 200
100								100, 200
Total Strategies	**36**	**72**	**108**	**144**	**180**	**216**	**252**	**288**
Total No. of combination				**1296**				

Exponential Moving Average – EMA:
An exponential moving average (EMA) (Investopedia, 2021) provides the most recent data points, more weight, and relevance. The exponential moving average (EMA) considers recent price movements compared to the simple moving average, which gives equal weight to all observations in the timeframe.

Relative Strength Index – RSI:
In technical analysis, the relative strength index (RSI) (Investopedia, 2021) is a momentum indicator. It is used to examine "overbought" and "oversold" circumstances in stock prices. The RSI is shown as an oscillator that fluctuates between two extremes and has a range of 0 to 100. The RSI can help determine if a stock has had greater buying or selling pressure throughout the trading period.

Data Analysis and Interpretation:
Based on the moving average crossover buying and selling rule, a total 1296 strategies were tested, and 19 key results were analyzed against each strategy for each stock. Based on the Sharpe ratio ranking, it was observed that when the EMA-9 crossover and the EMA-20 is in an upward direction is the optimum strategy

out of 1296 strategies for buying any scripts from our sample. Similarly, when the EMA-1 crossover to EMA-20 is in the downward direction, it is the optimum strategy to exit from the particular scripts that we analyzed with respect to compound annual growth rate (CAGR). The 19 key results for the buying rule of EMA (9, 20) crossover and selling rule EMA (1, 20) crossover is summarized in the Table 3A and Table 3B below:

Table 3A

Moving Average Cross over Optimum Strategy – Buy EMA (9, 20); Sell EMA (1, 20): Pre- and during COVID-19 Period

EMA (9,20); EMA(1,20)	Adani Port	Airtel	HDFC Bank	HUL	Infosys	L&T
Total Trades	65	77	67	60	60	58
Success Trades	18	21	25	22	21	18
Failure Trades	47	56	42	38	39	40
Success Trade (%)	27.7	27.3	37.3	36.7	35	31
Failure Trade (%)	72.3	72.7	62.7	63.3	65	69
Avg profit per trade (%)	9.9	4.6	5.1	5.2	5.8	6.2
Avg loss per trade (%)	-2.5	-2.5	-1	-1.3	-1.8	-1.7
Min loss (%)	0	0	-0.1	-0.2	-0.1	-0.4
Max loss (%)	-13.7	-6.1	-4.7	-5	-9.6	-5.2
Min gain (%)	0.5	0.2	0.1	0.1	0.2	0.2
Max gain (%)	41.1	15.4	38.1	23.3	25.3	45.3
Risk-reward	3.89	1.86	5.23	3.97	3.14	3.66
Total strategy return (%)	48.5	-38.2	115	78.9	51	38.4
CAGR (%)	7.6	-8.5	15.2	11.4	7.9	6.2
Geometric Mean Return (%)	0.6	-0.6	1.1	1	0.7	0.6
Std deviation of return	0.08	0.04	0.06	0.05	0.06	0.07
Sharpe Ratio	0.32	-3.22	1.84	1.35	0.53	0.18
Skewness	2.93	1.92	4.87	2.7	2.43	5.17
Kurtosis	10.56	3.9	29.83	9.14	7.25	32.06
Buy & Hold CAGR (%)	21.28	10.11	20.30	20.59	18.74	10.49

Source: Author's calculation

Table 3B

Moving Average Crossover optimum strategy – Buy EMA (9, 20); Sell EMA (1, 20): Pre and during COVID-19 Period

EMA (9,20); EMA(1,20)	Maruti	Power Grid	Reliance	Sun Pharma	Tata Steel	UPL	Ultratech
Total Trades	55	60	68	67	53	59	65
Winning trades	19	15	22	16	19	21	21
Losing trades	36	45	46	51	34	38	44
Winning Trade (%)	34.5	25	32.4	23.9	35.8	35.59	32.31
Losing Trade (%)	65.5	75	67.6	76.1	64.2	64.41	67.69
Avg profit per trade (%)	8.1	5.2	8.4	4.4	15.4	8.32	6.39
Avg loss per trade (%)	-1.7	-1.8	-1.8	-2	-3.3	-2.75	-1.89
Min loss (%)	-0.2	-0.2	0	-0.1	-0.1	-0.21	-0.06
Max loss (%)	-8.6	-8.2	-4.1	-6.4	-10	-13.21	-8.30
Min gain (%)	0.1	0.1	0.1	0.3	0.5	0.55	0.14
Max gain (%)	37.9	24.8	45.2	13.4	68.5	36.49	31.75
Risk-reward	4.72	2.82	4.78	2.22	4.61	3.03	3.39
Total strategy return (%)	120.7	-9.9	136.4	-29.4	285.5	68.30	50.86
CAGR (%)	15.8	-1.9	17.3	-6.2	28.4	10.12	7.91
Geometric Mean Return	1.5	-0.2	1.3	-0.5	2.6	0.89	0.63

EMA (9,20); EMA(1,20) (%)	Maruti	Power Grid	Reliance	Sun Pharma	Tata Steel	UPL	Ultratech
Std deviation of return	0.07	0.04	0.08	0.03	0.14	0.08	0.06
Sharpe Ratio	1.49	-1.56	1.59	-3.31	1.62	0.61	0.49
Skewness	2.97	3.12	3.55	1.62	2.89	2.48	2.99
Kurtosis	11.33	16.33	15.69	3.82	9.2	7.49	12.21
Buy & Hold CAGR (%)	8.02	9.09	28.77	-2.69	31.91	20.75	16.96

Source: Author's calculation

It can be observed from the above table that the CAGR for the conventional buy-and-hold approach for 13 scripts, which were analyzed in most of the stocks, outperform compared to the optimum strategy, which we shortlisted based on the Sharpe ratio ranking. Further, we have shortlisted the strategy based on the highest CAGR generated for each stock that was analyzed in Table 4A and Table 4B below. It is observed that there is no single strategy that works well across the selected stocks. However, the best strategies for individual stocks have been worked out for maximizing the CAGR.

Table 4A

Moving Average Crossover strategy based on highest CAGR: Pre and during COVID-19 Period

	Adani Port	Airtel	HDFC Bank	HUL	Infosys	L&T
Buy: EMA	(5, 15)	(15, 100)	(3, 20)	(5, 15)	(20, 200)	(1, 50)
Sell: EMA	(5, 20)	(9, 20)	(5, 50)	(20, 200)	(5, 100)	(9, 20)
Total Trades	36	16	14	3	10	24
Success trades	17	9	9	2	4	11
Failure trades	19	7	5	1	6	13
% Success	47.22	56.25	64.29	66.67	40.00	45.83
% Failure	52.78	43.75	35.71	33.33	60.00	54.17
Avg profit per trade (%)	12.23	11.18	14.41	74.38	32.06	11.63
Avg loss per trade (%)	-3.46	-3.75	-1.52	-0.40	-3.33	-3.02
Min loss (%)	-0.41	-1.57	-0.88	-0.40	-1.49	-1.08
Max loss (%)	-13.68	-7.50	-2.69	-0.40	-5.70	-6.94
Min gain (%)	0.04	0.84	0.09	10.00	3.15	0.37
Max gain (%)	103.76	43.65	46.99	138.77	90.50	59.43
Risk-reward	3.54	2.98	9.45	186.78	9.63	3.85
Total strategy return (%)	172.81	88.77	187.44	161.60	118.49	102.47
CAGR (%)	**20.41**	**12.48**	**21.58**	**19.48**	**15.57**	**13.95**
Geometric Mean Return (%)	2.83	4.05	7.83	37.79	8.13	2.98
Std deviation of return	0.19	0.12	0.15	0.78	0.30	0.14
Sharpe Ratio	0.83	0.61	1.09	0.19	0.36	0.65
Skewness	4.64	2.27	1.72	1.70	2.61	3.25
Buy & Hold CAGR (%)	**21.28**	**10.11**	**20.30**	**20.59**	**18.74**	**10.49**

Table 4B

Moving Average Crossover Strategy Based on Highest CAGR: Pre and during COVID-19 Period

	Maruti	Power grid	Reliance	Sun pharma	Tata Steel	UPL	Ultratech
Buy: EMA	(1,3)	(100,200)	(1,50)	(50,200)	(1,5)	(3,9)	(3,9)
Sell: EMA	(1,3)	(50,100)	(1,3)	(15,100)	(20,50)	(1,50)	(9,20)
Total Trades	204	4	163	4	9	36	25
Success trades	76	2	61	3	6	12	11
Failure trades	128	2	102	1	3	24	14
% Success	37.25	50.00	37.42	75.00	66.67	33.33	44
% Failure	62.75	50.00	62.58	25.00	33.33	66.67	56
Avg profit per trade (%)	3.43	30.40	3.87	15.50	47.97	16.56	14.14
Avg loss per trade (%)	-1.21	-8.87	-1.00	-6.46	-9.42	-2.24	-3.48
Min loss (%)	-0.04	-8.54	-0.04	-6.46	-1.75	-0.09	-1.07
Max loss (%)	-7.13	-9.20	-3.76	-6.46	-16.63	-8.25	-11.85
Min gain (%)	0.03	16.60	0.09	4.06	7.47	0.09	1.27
Max gain (%)	14.85	44.20	22.47	38.11	164.09	35.03	59.30
Risk-reward	2.83	3.43	3.88	2.40	5.10	7.38	4.07
Total strategy return (%)	160.59	39.63	245.14	40.25	458.46	241	135.34
CAGR (%)	**19.40**	**6.37**	**25.77**	**6.46**	**37.49**	**25.49**	**17.17**
Geometric Mean Return (%)	0.47	8.70	0.76	8.82	21.06	3.47	3.48
Std deviation of return	0.03	0.25	0.04	0.19	0.55	0.11	0.14
Sharpe Ratio	4.58	0.05	5.69	0.08	0.59	1.79	0.85
Skewness	1.76	0.92	2.91	1.58	2.16	1.60	2.66
Kurtosis	4.10	-0.94	10.82	2.97	5.13	1.37	8.70
Buy & Hold CAGR (%)	**8.02**	**9.09**	**28.77**	**-2.69**	**31.91**	**20.75**	**16.96**

It can be observed from the above Table 4B that the strategy that we have shortlisted for individual stocks has outperformed in terms of CAGR against the buy-and-hold approach in most of the scripts.

Table 5

Moving Average Crossover strategy based on highest CAGR: During COVID-19 Period

	Adani Port	Airtel	HDFC Bank	HUL	Infosys	L&T
Buy: EMA	(1, 9)	(15, 20)	(5, 15)	(1, 20)	(1, 3)	(1, 100)
Sell: EMA	(9, 15)	(9, 20)	(15, 50)	(3,9)	(5, 100)	(9, 15)
Total Trades	5	4	2	16	2	4
Success trades	3	2	2	7	1	2
Failure trades	2	2	0	9	1	2
% Success	60.00	50.00	100.00	43.75	50.00	50.00
% Failure	40.00	50.00	0.00	56.25	50.00	50.00
Avg profit per trade (%)	46.64	18.06	18.34	5.36	97.07	31.77
Avg loss per trade (%)	-3.10	-3.43	0.00	-1.84	-4.79	-1.78
Min loss (%)	-0.41	-3.12	0.00	-0.10	-4.79	-0.49
Max loss (%)	-5.78	-3.73	0.00	-4.45	-4.79	-3.07
Min gain (%)	3.09	11.74	3.05	0.65	97.07	6.41

Max gain (%)	110.54	24.38	33.63	10.92	97.07	57.13
Risk-reward	15.05	5.27	–	2.91	20.28	17.85
Total strategy return (%)	157.18	29.61	37.72	21.15	87.64	61.28
CAGR (%)	**105.09**	**21.80**	**27.52**	**15.71**	**61.37**	**43.83**
Geometric Mean Return (%)	20.79	6.70	17.35	1.21	36.98	12.69
Std deviation of return	0.48	0.13	0.22	0.05	0.72	0.28
Sharpe Ratio	2.07	1.25	1.04	2.25	0.78	1.37
Skewness	1.91	0.71	–	1.08	–	1.88
Kurtosis	3.67	-2.06	–	-0.04	–	3.58
Buy & Hold CAGR (%)	**63.62**	**3.79**	**14.94**	**8.78**	**47.56**	**9.39**

Table 6

Moving Average Crossover strategy based on highest CAGR: During COVID-19 Period

	Maruti	Power grid	Reliance	Sun pharma	Tata Steel	UPL	Ultratech
Buy: EMA	(3,15)	(1,15)	(1,3)	(1,9)	(1,3)	(1,5)	(15.20)
Sell: EMA	(1,50)	(1,3)	(3,5)	(3,5)	(9,15)	(1,5)	(9,20)
Total Trades	4	34	23	21	4	36	5
Success trades	3	12	11	11	4	19	4
Failure trades	1	22	12	10	0	17	1
% Success	75.00	35.29	47.83	52.38	100.00	52.78	80.00
% Failure	25.00	64.71	52.17	47.62	0.00	47.22	20.00
Avg profit per trade (%)	12.38	4.92	7.03	7.05	39.24	6.09	16.07
Avg loss per trade (%)	-0.38	-1.73	-1.70	-2.14	0.00	-1.56	-1.71
Min loss (%)	-0.38	-0.38	-0.26	-0.11	0.00	-0.12	-1.71
Max loss (%)	-0.38	-5.83	-2.63	-4.82	0.00	-3.30	-1.71
Min gain (%)	2.25	0.04	0.10	0.73	0.26	0.10	0.29
Max gain (%)	26.22	15.80	33.91	31.79	65.35	35.99	57.62
Risk-reward	32.88	2.84	4.12	3.30	–	3.90	9.41
Total strategy return (%)	39.72	19.79	65.90	65.59	251.75	123.50	65.38
CAGR (%)	**28.96**	**14.72**	**46.95**	**46.74**	**160.23**	**84.33**	**46.60**
Geometric Mean Return (%)	8.72	0.53	2.23	2.43	36.95	2.26	10.58
Std deviation of return	0.12	0.04	0.08	0.08	0.28	0.07	0.25
Sharpe Ratio	2.00	2.29	5.41	5.42	5.62	10.97	1.64
Skewness	1.45	1.81	3.26	2.87	-1.29	3.20	2.18
Kurtosis	1.88	4.07	12.76	10.50	2.38	12.97	4.80
Buy & Hold CAGR (%)	**2.16**	**15.22**	**27.38**	**40.46**	**86.82**	**37.56**	**33.52**

In order to check how these moving average crossover strategies perform during volatile periods, these were applied separately to the same 13 stocks and considered only during the COVID-19 period. For the strategy to find the highest CAGR generated for each stock during COVID-19 period, the moving average crossover strategies surpassed the conventional approach for 12 out of 13 scripts. This indicates that during a volatile period, the moving average crossover strategies would generate more returns than the stocks using the buy-and-hold approach.

Conclusion

Based on the 1296 MA combinations applied to the highest weight of stock from each sector of the Nifty 50 Index, namely automobile, cement and cement products, construction, consumer goods, fertilizers and pesticides, financial services, IT, metals, oil and gas, pharma, power, services, and telecom, it can be concluded that a common approach does not outperform a buy-and-hold approach. However, the buying strategy EMA-15 upward crossover to EMA-100 and selling strategy EMA-9 downward to EMA-20 has generated better CAGR than the simple buy-and-hold strategy for Airtel [EMA (15,100) and EMA (9,20)]. Similarly, in the case of HDFC Bank [buying rule EMA (3,20) and selling rule EMA (5,50)]; L&T [EMA (1,50) and EMA (9,20)]; Maruti [EMA (1,3) and EMA (1,3)]; Sun pharma [EMA (50,200) and EMA (15,100)]; Tatasteel [EMA (1,5) and EMA (20,50)]; UPL [EMA (3,9) and EMA (1,50)]; and for UltraTech [EMA (3,9) and EMA (9,20)] have outperformed. It can be concluded by our empirical observation that out of 13 selected stocks, in the case of 8 stocks (61% case), the EMA crossover strategy has outperformed the buy-and-hold strategy for the study period 01st January 2016 to 26th May 2021.

Further, during the COVID-19 period, the buying strategy EMA-1 upward crossover to EMA-9 and selling strategy EMA-9 downward to EMA-15 has generated better CAGR than the simple buy-and-hold strategy for Adani Port [EMA (1,9) and EMA (9,15)]. Similarly, in the case of Airtel [buying rule EMA (15,20) and selling rule EMA (9,20)]; HDFC Bank [buying rule EMA (5,15) and selling rule EMA (15,50)]; HUL [Buying rule EMA (1,20) and selling rule EMA (3,9)]; Infosys [buying rule EMA (1,3) and selling rule EMA (5,100)]; L&T [EMA (1,100) and EMA (9,15)]; Maruti [EMA (3,15) and EMA (1,50)]; Reliance [buying rule EMA (1,3) and selling rule EMA (3,5)]; Sun pharma [EMA (1,9) and EMA (3,5)]; Tatasteel [EMA (1,3) and EMA (9,15)]; UPL [EMA (1,5) and EMA (1,5)]; and for UltraTech [EMA (15,20) and EMA (9,20)] have outperformed. It can be concluded by our empirical observation that in the case of during the COVID-19 period, 12 out of 13 selected stocks have an EMA crossover strategy that has outperformed the buy-and-hold strategy.

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