Testing Of EMA And Stock Return Predictability In BRICS Stock Markets

Poonam[1] , N.S. Malik[2]

[1]Research Scholar Haryana School of Business, Guru Jambheshwar University of Science & Technology, Hisar, Haryana 125001, India

[2]Professor Haryana School of Business, Guru Jambheshwar University of Science & Technology, Hisar, Haryana 125001, India

Abstract

The aim of this study is to evaluate the performance of the exponential moving average (EMA) strategy within the BRICS stock markets from June 2012 to June 2022. We examined three specific EMA rules: EMA(5-20), EMA(5-50), and EMA(5-200) to assess their ability to generate returns. Our findings indicated that the results of the EMA-based strategy were statistically insignificant in most cases, with the exception of some instances in the South African stock market. Overall, the EMA-based active strategy did not outperform the buy-and-hold (B-H) strategy, as the alpha ratio and compound annual growth rate (CAGR) were negative during the study period, except for the Russian stock market.

Keywords – Technical trading, EMA, Stock market, BRICS.

1. Introduction

Technical analysis consists of a multitude of trading techniques. Technical analysis is a process of forecasting stock prices on the basis of information from past prices and other related news about security trading. It is assumed in Technical analysis that shifts in supply and demand of share prices can be detected by using charts of market action. This technique of technical trading is attributed to Charles Dow in the late 1800s (Brock et al., 1992). The development of this early work has led to the rise of a number of theories and techniques which are widely employed by various investors, market professionals and practitioners to make investment decisions and to forecast the new equilibrium prices. As said by Brock, Lakonishok, and LeBaron (1992, page 1732) (BLL hereafter), technical analysis has been enjoying a resurgence in bourses. The commentary on market and individual securities published by all major brokerage firms and the newsletters reported by various experts are based on technical analysis. Technical analysis assists traders in interpreting the currently available

information and allows traders to update their beliefs (Chang et al., 2017).

Technical analysis consists of many tools and techniques that are widely used as oscillators and indicators. Moving averages are common to them. Moving averages are a technical trading strategy that is very popular and widely used by financial traders in the stock markets because Moving average techniques are easy to understand (Ellis & Parbery, 2004). Under this technique, buy and sell decisions regarding stock indices are initiated after comparing the short-run moving average of the stock price with its long-run moving counterpart. Such trading strategies are also known as long-short bands, where long and short are the length of periods spanned in the long-run and short-run moving averages, respectively, and the band is the percentage difference required to generate a signal (Gunasekarage & Powerb, 2001). The objective of Moving Averages is to identify the trends and movements towards changes in prices where the buy signal occurs when the current stock price crosses the MAs from below, i.e., current prices are higher than the moving average, and the sell signal occurs when the opposite is the case.

The Simple Moving Average (SMA) is the simplest and most commonly used Technical analysis tool among financial market traders. It calculates the mean value of data over a given period.

The Exponential Moving Average (EMA) is used mostly as a trend-tracking tool rather than a Simple Moving Average tool. It gives more weightage to more recent data and responds quickly to changes in prices (da Costa et al., 2015).

The present study endeavours to examine the performance of the technical trading rule based on the Exponential Moving Average (EMA) in BRICS countries for 10 years from June 2012 to June 2022.

The remaining paper is segregated as follows: Section 2 contains a review of existing literature. Sections 3 and 4 are for hypotheses, research methodology, and the data set under investigation. Section 5 represents the results of our empirical research, and Section 6 contains some concluding remarks.

2. Review of literature

Many empirical studies were conducted to check the performance of moving average, relative strength index, stochastic oscillators and technical trading rules. However, mixed results were reported on the moving average rule. Supporters of these rules argue that the analysis of moving averages helps identify the trends in the series by smoothing out any volatility. Brock et al. (1992) provided strong support for the technical trading strategies and found that the returns obtained from these strategies were not consistent with four popular null models: the AR (1), the random walk, the Exponential GARCH and the GARCH-M. Similar results were found by Zhu & Zhou (2012) who analysed the usefulness of

moving average trading rule from a standard asset allocative perspective by providing a theoretical justification. Bessembinder & Chan (1997) enhanced the study of Brock et al. (1992) and found that the determination of the source of the technical forecast power documented by Brock et al. remained an interesting and unresolved issue. Malik & Singla (2016) found significant results by EMA considering leading stock markets worldwide. Vashistha & Kumar (2012) also supported the predictability of technical analysis in their study on BSE-SENSEX employing Ralph Nelson Elliott Wave theory.

However, contrasting results were reported by Ratner and Leal (1999) and Horne and Parker (1968). Ratner & Leal (1999) put forward that VMA trading rules did not profitably forecast the future stock price movements when the trading cost was considered, in most of the emerging stock markets Similarly, Horne and Parker (1968) argued that future stock prices could not be forecasted by comparing past and present stock prices and that consistent profit by trading in securities could not be realized by employing weighted moving average decision rule. Reitz (2006) referred to technical analysis as a cheap proxy for Bayesian learning. Hoffmann & Shefrinc (2014) reported that individual investors earn less return by using technical analysis as they hold more concentrated portfolios and choose a risk exposure with a higher non-systematic ratio to total risk. Fabozzi et al. (2007) found that various models employed to predict stock returns are now used as quantitative fund management tools.

Sobreiro et al. (2016) suggested that in the case of BRICS and emerging markets, the distinct combination of SMA and EMA techniques of moving average produced differing performances, among which, the combination based on the SMA-SMA performed better than other combinations. Bianconi et al. (2012) reported the dynamic conditional correlation (DCC) between bond returns, stock returns and U.S. financial stress in BRIC countries after the financial crisis in September 2012, except in India where bond returns exhibited exceptional behaviour. The deviation between BRIC bonds and the stock market was less than that of the deviation between the BRIC bond market and the measure of U.S. financial stress in the long run.

LeBaron (1992) demonstrated a direct relation between the persistence of stock returns for a large firm index, i.e., the Dow Jones index and trading volume employing a bootstrap simulation technique. Buchanan et al. (2010) examined the underlying sources of performance benefits in emerging countries by re-examining the Barry, Peavy and Rodriguez (1998) paper and reported that by focusing particularly on a limited set of stocks of emerging countries with a French civil law foundation and stocks that were moderately investable, an investor could be benefitted.

Ellis & Parbery (2004) conducted a comparative analysis of Adaptive Moving Average and Simple Moving Average by analysing the Australian All Ordinaries, Dow Jones Industrial Average, and Standard and Poor's 500 stock market indices and suggested that Adaptive Moving Average was an apparent natural progression of trading system based on simple moving average however dismissed its ability to properly respond to changing market conditions. However, da Costa et al. (2015) found consistent results from SMA, EMA and other techniques. LeBaron (1992) utilised non-parametric techniques to explore the possibility of improved forecasting for stock returns and foreign exchange rates using observed nonlinearities in the two series. Forecast improvements were observed for both the series, i.e., stock returns and foreign exchange rates; however, for stock returns, the improvements were small/marginal. Broto (2012) analysed the effects of daily foreign exchange interventions in four Latin American countries- Chile, Columbia, Mexico and Peru while considering the inflation targets and reported asymmetrical effects. Vandewalle et al. (1999) analysed the relevance of moving average for Physics by considering the Fractional Brownian motions and concluded that finance could contribute to Physics where specific transform could be used to investigate various structures in signals, such as trends, noise, cycles, etc.

The present study attempts to check and revalidate the profitability of the technical trading rule based on the Exponential Moving Average (EMA) in BRICS countries by considering the period from June 2012 to June 2022.

3. Hypothesis

H0: There is no significant difference between the EMA-based strategy returns and the buy-hold(B-H) strategy returns.

4. Data and Research Methodology

(1) Data

In this research, five stock markets have been considered as a sample. The data set consists of the daily closing prices of the stock indices of Brazil, Russia, India, China and South Africa, namely, Bovespa, RTSI, Nifty 50, Shanghai Composite (SSEC) and FTSE_JSE Top 40 over the period from 1st June 2012 to 30th June 2022 is obtained from investing.com.

(2) Methodology

The daily stock market returns ($\mathbf{R_t}$) have been calculated by taking natural logarithmic difference change of the BRICS stock indices individually i.e.,

$$\mathbf{R_t} = \mathbf{In}\left(\frac{\mathbf{P_t}}{\mathbf{P_{t-1}}}\right) \qquad \text{.....(1)}$$

Where Pt are the present closing value, and Pt-1 is the previous day's closing indices of the BRICS stock market.

Exponential Moving Average (EMA)

This is most common and frequently used by trend followers due to ease of computation and effective implementation; however, despite using simple moving average (SMA), exponential moving average (EMA) will be used in the study because it tends to be more sensitive and turns faster than SMA due to higher weight-age to current prices being the stock price behaviour parlance is dominated by short term memory. The calculation of n-day simple moving average(SMA) and exponential moving average(EMA) is as follows:

$$\text{EMA} = \text{Initial SMA: SMA} = \frac{1}{n}\sum_{i=t-n+1}^{t} c_i \qquad \text{.....(2)}$$

$$= (C_t + C_{t-1} + \ldots\ldots\ldots\ldots\ldots\ldots + C_{t-n+2} + C_{t-n+1})/n$$

5 – day Multiplier = $\frac{\mathbf{2}}{[\mathbf{1} + \text{number of day}(\mathbf{5})]}$ = 33.33%

Similarly, multipliers for 20, 50 and 200 days are calculated.

$EMA_t = [(P_t - EMA_{t-1}) \times \text{Multiplier}] + EMA_{t-1}$ …. .(3)

Where Pt and EMAt-1 represent the index's closing price at time t is the exponential moving average at time **t-1**. For initial EMA **n-day, a** simple moving average is used. To generate buy (sell) signals, dual EMA is being computed, which tends to vary from investor to investor, wherein if the short-run moving average crosses (from below), the long-run moving average [$S_t(n) > L_t(m)$] buy signal is generated and vice-versa. A dual strategy will follow in this study [(5, 20), (5, 50), (5,200)] in an effort to help investors have both short-run and long-run views on the market to suit the risk-return profile of varied investors. To generate a buy (sell) signal, the short-term EMA (EMAS) should cross the long-term EMA (EMA_L) from below (above).

5. Empirical results and discussion

(1) Data and Summary statistics

Table I presents the summary statistics of daily returns for the BRICS stock markets over the past 10 years. The daily returns are computed by taking the natural log, which shows the difference in closing prices. The mean returns of all the sample countries are positive, and Brazil's mean returns are the highest among all the countries. The daily returns of Russia are highly volatile compared to other countries, as the Standard deviation (SD) is highest for the daily returns of Russia. The daily returns of all the sample countries are left-skewed, as all have negative returns. The kurtosis value is greater than 3, indicating that the returns distribution is leptokurtic, having heavier tails compared to the standard normal distributions.

Jarque-Bera statistic, which is used to check the normality of distribution, has less p-value than the 5% significance level. Hence, the null hypothesis for the test (that the returns are normally distributed) is rejected.

Table I : Descriptive Statistics for Daily Returns

Statistics	Brazil	Russia	India	China	South Africa
Mean	0.000309	0.000107	0.00047	0.000214	0.000304
Median	0.00028	0.000614	0.000588	0.000681	0.000715
Std. Dev.	0.016684	0.019933	0.012685	0.014449	0.012628
Kurtosis	13.07038	9.778996	20.97774	8.144337	8.642448
Minimum	-0.159938	-0.139486	-0.139038	-0.088729	-0.104504
Maximum	0.130228	0.132462	0.163343	0.070196	0.079071
Skewness	-0.614298	-0.484013	-0.089612	-0.764894	-0.197783
Jarque-Bera	12843.81	5884.929	39959.45	3502.142	3995.212
Prob.	0	0	0	0	0
Observations	2995	3012	2967	2918	2997

The formulae provided by Brock et al. (1992) are used to calculate t-statistic. The results of three different EMA rules, namely the 5-20 rule, 5-50 rule and 5-200 rule, for the sample period of 10 years, are provided in Tables II, III and IV, respectively. The results of a technical trading strategy based on the EMA (5-20) rule for 12 years sample is reported in Table II, “No. of Buy” and “No. of Sell” column represents the number of buy and sell signals generated by EMA rules. The Long (Buy) and Short (Sell) columns represent the mean returns of the active strategy. A long position is when the trader makes a long position when a buy signal is generated and holds it until the next sell signal is generated. The column labelled “Long-Short” represents the mean returns of the total EMA strategy. Values in the parentheses are the calculated values of t-statistics used to test the difference between buy return and sell return, the difference between the mean returns of long position and unconditional mean return and the difference between the mean short position return and unconditional mean return.

We labelled two strategies as long and short, as the short position is allowed in the second strategy when the sell signal is generated. The results indicate that the markets of the BRICS countries are upward trading, i.e., the number of Long(buy)

signals generated by the EMA rule is more than the sell signal. All mean returns are positive and compared with the passive strategy. The results of the South African stock market are significant, i.e., the returns from active strategy using the EMA 5/20 rule are more than the index return and in other markets named Brazil, Russia, India, and China are found insignificant, i.e., the returns from EMA 5/20 are either equal to or less than the buy and hold strategy.

Table II Results of EMA (5-20) (from June 2012 to June 2022)

Countries	Index	No. (Buy)	No. (Sell)	Long (Buy)	Short (Sell)	Long-Short (L-S)
Brazil	Bovespa	1641	1354	0.00030 (-0.21065)	0.00033 (0.23944)	0.00001 (-0.38979)
Russia	RTSI	1621	1391	0.00050 (0.63844)	-0.00035 (-0.70698)	0.00043 (1.16517)
India	Nifty	1868	1099	0.00045 (-0.05899)	0.00051 (0.08386)	0.00008 (-0.12373)
China	Shanghai	1585	1333	0.00052 (0.68257)	-0.00015 (-0.76605)	0.00035 (1.25454)
South Africa	FTSI	1819	1178	-0.00017 (-1.26076)	0.00103 (1.67454)**	-0.00051 (-2.54175)**

The numbers marked with one star (*) are for 10%, two stars (**) are for 10% and 5%, and three stars (***) are for all 1%, 5%, and 10% levels of significance corresponding to t-statistics.

The results of EMA 5-50 technical trading rules for a 10-year sample period are presented in Table III. The two strategies are labelled as long and short; the long position is allowed when the buy signal is generated, and the short position is allowed in

the second strategy when the sell signal is generated. The results show that the markets of the sample countries are trading upward, as no. The buy signals generated by the EMA 5-50 trading rule are more than the sell signals. All mean returns are positive and compared with the passive strategy. The results of one South African stock market are found significant because the returns from active strategy using the EMA 5-50 trading rule are more than the index return, and other markets, namely Brazil, Russia, India and China, are found insignificant.

Table III Results of EMA (5-50) (form June 2012 to June 2022)

Countries	Index	No. (Buy)	No. (Sell)	Long (Buy)	Short (Sell)	Long-Short (L-S)
Brazil	Bovespa	1703	1292	0.00041 (0.13199)	0.00018 (-0.15863)	0.00016 (0.25168)
Russia	RTSI	1665	1347	0.00064 (0.87388)	-0.00055 (-1.00638)	0.00060 (1.62836)
India	Nifty	1950	1017	0.00060 (0.36066)	0.00021 (-0.55482)	0.00032 (0.79303)
China	Shanghai	1478	1440	0.00030 (0.11128)	0.00013 (-0.11323)	0.00009 (0.19443)
South Africa	FTSI	1880	1117	-0.00010 (-1.07438)	0.00098 (1.5092)*	-0.00043 (-2.23717)**

The numbers marked with one star (*) are for 10%, two stars (**) are for 10% and 5%, and three stars (***) are for all 1%, 5%, and 10% levels of significance corresponding to t-statistics.

The results of the technical trading strategy based on the EMA 5-200 trading rule for a time period of 10 years sample are reported in Table IV. Results show that the BRICS Stock market is up-trending during the period because all three rules of EMA

generate more buy signals than sell signals. The results of South African Stock markets are found to be significant, i.e., the returns from active strategy using the EMA 5-200 technical rule are more than the index return. Another stock market is found insignificant.

Table IV Results of EMA (5-200) (form June 2012 to June 2022)

Countries	Index	No. (Buy)	No. (Sell)	Long (Buy)	Short (Sell)	Long-Short (L-S)
Brazil	Bovespa	1815	1180	0.00027 (-0.08263)	0.00037 (0.10999)	0.00002 (-0.16682)
Russia	RTSI	1580	1432	0.00004 (-0.09172)	0.00018 (0.09792)	-0.00006 (-0.16422)
India	Nifty	2182	785	0.00030 (-0.48115)	0.00095 (0.93973)	-0.00003 (-1.23227)
China	Shanghai	1357	1561	-0.00006 (-0.56862)	0.00045 (0.51795)	-0.00027 (-0.94099)
South Africa	FTSI	2160	837	-0.00014 (-1.25187)	0.00145 (2.32233)**	-0.00051 (-3.09776)***

The numbers marked with one star (*) are for 10%, two stars (**) are for 10% and 5%, and three stars (***) are for all 1%, 5%, and 10% levels of significance corresponding to t-statistics.

Table V. contains the risk-return analysis of the long and short strategy of the EMA (5-20) technical trading rule for the period of Nov. 2012 to Oct. 2022. In the present study, the index returns of respective stock markets of sample countries are taken as a benchmark to calculate the alpha ratio, which is the excess return over index return out of 5 markets. Transaction cost is highest for South Africa, being the no. of transactions is highest, and China has the lowest TC because the no. of trade is lowest in comparison to others. The Gross

Compound annual growth rate (CAGR) is highest for Russia, followed by China, whereas CAGR by EMA (5–20) is negative for the African stock market, and after taking transaction costs, the NET CAGR of Brazil and India also becomes negative. Only Russia and China generated positive alpha during the sample period, and Africa had the lowest alpha. The sharpie ratio is also highest for Russia and China. We fail to compute the CAGR of the South African market because of the heavy negative returns produced by the strategy.

The risk-return analysis of EMA's long and short strategy (5-50). The index returns of the respective stock markets of the sample countries are considered a benchmark to calculate the alpha ratio, which is the excess return over the index return. Transaction cost is highest for Africa as the number of transactions is highest, whereas China has the lowest TC because the number of trade is lowest in China compared to others. The Gross and Net Compound annual growth rate (CAGR) is highest for Russia, followed by China, whereas the CAGR by the EMA (5-50) trading rule is negative for the African stock market. Also, only Russia generated positive alpha during the sample period, whereas other countries' Alpha ratio is negative, and Africa has the lowest alpha. The Sharpie ratio is also highest for Russia only, and for other countries, the Sharpie ratio is negative and the lowest value for Africa.

The long and short strategies of the EMA (5-200) trading rule are as follows. Transaction cost is highest for Africa as the no. of transactions is highest, and China has the lowest TC because the no. of trade is lowest in comparison to others. The Gross Compound annual growth rate (CAGR) is positive and highest for Brazil, whereas it is negative for other countries, i.e., China, Africa, Russia, and India stock markets and Net CAGR is negative for all the stock markets. Alpha and Sharpie ratios are also negative for all the sample countries during the sample period, being the lowest for the South African stock market.

Table V Risk-Return Analysis of Long-Short Strategy (From June 2012 to June 2022)

Rule	Countries	Index	No. of Trade	Trade Repetition (in days)	Gross Returns (%)		TC%	NET Returns %		Alpha index Ratio	Sharpe Ratio %
					Aggregate	CAGR	Aggregate	Aggregate	CAGR		
EMA (5-20)	Brazil	Bovespa	390	7.679	-26.556	-2.539	38.275	-64.832	-8.340	-119.051	-451.383
	Russia	RTSI	366	8.230	129.524	7.169	35.773	93.752	5.666	97.377	309.023
	India	Nifty 50	362	8.196	27.898	2.072	36.185	-8.286	-0.718	-111.594	-556.463
	China	Shanghai	318	9.176	102.920	6.074	31.274	71.647	4.605	40.584	177.671
	South Africa	FTSI	390	7.685	-152.101	#NUM!	38.878	-190.980	#NUM!	-243.667	-1220.748
EMA (5-50)	Brazil	Bovespa	226	13.252	35.451	2.561	22.568	12.883	1.015	-57.044	-216.282
	Russia	RTSI	214	14.075	180.503	8.975	21.433	159.069	8.256	148.355	470.801
	India	Nifty 50	192	15.453	95.873	5.762	19.269	76.604	4.854	-43.619	-217.507
	China	Shanghai	222	13.144	15.984	1.243	21.808	-5.825	-0.499	-46.353	-202.928
	South Africa	FTSI	298	10.057	-126.312	#NUM!	30.143	-156.454	#NUM!	-217.878	-1091.545
EMA	Brazil	Bovespa	108	27.731	4.728	0.386	10.595	-5.867	-0.503	-87.767	-332.770

(5-200)	Russia	RTSI	98	30.735	-16.360	-1.478	9.818	-26.178	-2.498	-48.508	-153.938
	India	Nifty 50	104	28.529	-9.426	-0.822	10.294	-19.720	-1.814	-148.919	-742.584
	China	Shanghai	120	24.317	-77.612	-11.726	12.058	-89.670	-17.236	-139.948	-612.677
	South Africa	FTSI	158	18.968	-151.861	#NUM!	16.393	-168.254	#NUM!	-243.427	-1219.543

Notes:

1. No. of trade is counted 1 for entering in long/short position, and another is for closing the long/short position
2. Trade repletion is calculated by no. of trade divided by no. of days in the sample period
3. TC is assumed to be 0.01 of closing prices because it is usually variable between clients based on their volume of trade.
4. Alpha index ratio is difference of actual return(net of TC) and the risk-free return(index return/ buy and hold return)
5. Sharpie ratio = alpha ratio/annual SD
6. Annual Standard deviation(SD) = SD of daily return × $\sqrt{250\ \text{Days}}$ i.e., actual average (2977/12=248.08) trading day per year in BRICS

6. Conclusion

With this study, we conclude that the results from the exponential moving average strategy in the BRICS stock market after the global financial crisis are found insignificant in most cases except in some cases in South Africa. During this period, the stock market showed an upward trend because the strategy generated more buy signals than sales signals. However, the active strategy fails to gain more return than the passive strategy, i.e., the buy-hold strategy. In terms of alpha ratio and CAGR, EMA(5-20) and EMA(5-50) rules have produced positive returns in only the Russian stock market.

References

1. Bessembinder, H., & Kaufman, H. M. (1997). A comparison of trade execution costs for NYSE and NASDAQ-listed stocks. Journal of Financial and Quantitative Analysis, 287-310.
2. Bianconi, M., Yoshino, J. A., & De Sousa, M. O. M. (2013). BRIC and the US financial crisis: An empirical investigation of stock and bond markets. Emerging Markets Review, 14, 76-109.
3. Buchanan, B. G., English II, P. C., & Gordon, R. (2011). Emerging market benefits, investability and the rule of law. Emerging markets review, 12(1), 47-60.
4. da Costa, T. R. C. C., Nazário, R. T., Bergo, G. S. Z., Sobreiro, V. A., & Kimura, H. (2015). Trading system based on the use of technical analysis: A computational experiment. Journal of Behavioral and Experimental Finance, 6, 42-55.
5. Ellis, C. A., & Parbery, S. A. (2005). Is smarter better? A comparison of adaptive, and simple moving average trading strategies. Research in International Business and Finance, 19(3), 399-411.
6. Gerritsen, D. F. (2016). Are chartists artists? The determinants and profitability of recommendations based on technical analysis. International Review of Financial Analysis, 47, 179-196.
7. Hoffmann, A. O., & Shefrin, H. (2014). Technical analysis and individual investors. Journal of Economic Behavior & Organization, 107, 487-511.
8. Hsu, P. H., Hsu, Y. C., & Kuan, C. M. (2010). Testing the predictive ability of technical analysis using a new stepwise test without data snooping bias. Journal of Empirical Finance, 17(3), 471-484. Gunasekarage, A., & Power, D. M. (2001). The profitability of moving average trading rules in South Asian stock markets. Emerging Markets Review, 2(1), 17-33.
9. LeBaron, B. (1992). Forecast improvements using a volatility index. Journal of Applied Econometrics, 7(S1), S137-S149.

10. LeBaron, B. (1992). Do moving average trading rule results imply nonlinearities in foreign exchange markets?. Social Systems Research Institute, University of Wisconsin.
11. LeBaron, B. D. (1992). Persistence of the Dow Jones index on rising volume. University of Wisconsin.
12. Malik, N., & Singla, R. (2016). Role of EMA in Technical Analysis: A Study of Leading Stock markets Worldwide. Finance India, XXX(3), 919-942.
13. Reitz, S. (2006). On the predictive content of technical analysis. The North American Journal of Economics and Finance, 17(2), 121-137.
14. Sinkovics, R. R., Yamin, M., Nadvi, K., & Zhang, Y. (2014). Rising powers from emerging markets? The changing face of international business. 0969-5931, 23(4), 675-679.
15. Sobreiro, V. A., da Costa, T. R. C. C., Nazário, R. T. F., e Silva, J. L., Moreira, E. A., Lima Filho, M. C., ... & Zambrano, J. C. A. (2016). The profitability of moving average trading rules in BRICS and emerging stock markets. The North American Journal of Economics and Finance, 38, 86-101.
16. Vandewalle, N., Ausloos, M., & Boveroux, P. (1999). The moving averages demystified. Physica A: statistical mechanics and its applications, 269(1), 170-176.
17. Vashishtha, V. M., & Kumar, P. (2013). 50 years of immunization in India: progress and future. Indian pediatrics, 50(1), 111-118.
18. Zhu, Y., & Zhou, G. (2009). Technical analysis: An asset allocation perspective on the use of moving averages. Journal of Financial Economics, 92(3), 519-544.