“Application of multi-criteria decision analysis for investment strategies in the Indian equity market”

AUTHORS	Sudipa Majumdar Rashita Puthiya Nandan Bendarkar

ARTICLE INFO	Sudipa Majumdar, Rashita Puthiya and Nandan Bendarkar (2021). Application of multi-criteria decision analysis for investment strategies in the Indian equity market. *Investment Management and Financial Innovations*, *18*(3), 40-51. doi:10.21511/imfi.18(3).2021.04
DOI	http://dx.doi.org/10.21511/imfi.18(3).2021.04
RELEASED ON	Wednesday, 04 August 2021
RECEIVED ON	Sunday, 27 June 2021
ACCEPTED ON	Monday, 02 August 2021

LICENSE	This work is licensed under a Creative Commons Attribution 4.0 International License

JOURNAL	"Investment Management and Financial Innovations"
ISSN PRINT	1810-4967
ISSN ONLINE	1812-9358
PUBLISHER	LLC “Consulting Publishing Company “Business Perspectives”
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
33	0	8

© The author(s) 2021. This publication is an open access article.

BUSINESS PERSPECTIVES

LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine

www.businessperspectives.org

Sudipa Majumdar (United Arab Emirates), **Rashita Puthiya** (United Arab Emirates), **Nandan Bendarkar** (United Arab Emirates)

APPLICATION OF MULTI-CRITERIA DECISION ANALYSIS FOR INVESTMENT STRATEGIES IN THE INDIAN EQUITY MARKET

Abstract

In the Indian equity market, the Systematic Investment Plan (SIP) is the most popular strategy due to its convenience for disciplined investing regardless of market conditions. This study analyzes the excess returns of an extensive dataset of listed Indian companies from 2010 to 2019, along with a value-based version of the Multi-Criteria Decision Analysis (MCDA), to identify top performing stocks, based on their sectors and market capitalization. The findings of the study provide empirical evidence of Value Averaging (VA) as a viable alternative strategy over SIP (also known as Dollar Cost Averaging or Rupee Cost Averaging) as 352 out of 359 companies yielded higher returns under VA. The superiority of the VA strategy over the SIP was particularly marked in the consumer goods, financial services and industrial manufacturing sectors, with a clear dominance of small cap companies. The results also show that risk factors for VA strategy play an important role and should be taken into account, rather than base investment decisions on excess returns alone. The efficiency scores of individual stocks provide important insights for mutual funds, financial brokers and individual investors in India.

Keywords investment strategy, systematic investment plan, value averaging, National Stock Exchange, value based DEA

JEL Classification G11, C67

Received on: 27th of June, 2021
Accepted on: 2nd of August, 2021
Published on: 4th of August, 2021

© Sudipa Majumdar, Rashita Puthiya, Nandan Bendarkar, 2021

Sudipa Majumdar, Ph.D., Senior Lecturer, Business Department, Middlesex University Dubai, United Arab Emirates. (Corresponding author)

Rashita Puthiya, Lecturer, Accounting and Finance Department, Middlesex University Dubai, United Arab Emirates.

Nandan Bendarkar, Partner, MBK Auditing, United Arab Emirates.

This is an Open Access article, distributed under the terms of the Creative Commons Attribution 4.0 International license, which permits unrestricted re-use, distribution, and reproduction in any medium, provided the original work is properly cited.

Conflict of interest statement:
Author(s) reported no conflict of interest

INTRODUCTION

Individual investors and active portfolio managers seek to maximize their risk-adjusted excess returns by adopting various strategies such as lumpsum investing, Systematic Investment Plan (SIP) and Value Averaging (VA). Lumpsum investment involves an investor depositing a significant sum of money as a single payment and holding it through the entire investment horizon. Alternatively, SIP (also known as Dollar Cost Averaging or Rupee Cost Averaging) is a strategy wherein an investor puts a fixed amount into a financial asset at regular intervals (monthly, quarterly or annually). The popularity of SIP stems from the fact that it is an easy strategy to follow and involves a straightforward financial discipline to invest. If the money is invested in the equity market, the investor puts in this amount regardless of the price movement of the stocks; this implies that the investor buys more shares when prices fall and a lesser number of shares as the prices rise. In contrast, value averaging (VA), introduced by Edelson (2006), desires to achieve a target portfolio value (in terms of the growth in the total investment) at regular intervals rather than invest a fixed amount. As in SIP, the VA strategy would also involve buying more shares when prices fall and fewer shares when prices are high (Malkiel, 1999) to achieve the set target growth rate. The notable difference would be the quantum of shares purchased under different market scenarios.

http://dx.doi.org/10.21511/imfi.18(3).2021.04

The choice of investment strategies would vary depending on investment philosophy, market movements, future beliefs about the economy, optimum time horizon and demand for liquidity (Damodaran, 2012). Interestingly, in the Indian equity market, there has been overwhelming popularity of the SIP whereby SIP annual contribution to mutual funds increased from INR 439,210 million in 2016–2017 to INR 1,000,840 million in 2019–2020, according to the data from the Association of Mutual Funds in India (AMFI), registering a CAGR of 31.6% over the three years. Mutual funds in India have strongly promoted SIP as the most preferred investment strategy, as it is the most convenient financial planning option, especially for new investors. Lumpsum investing requires significant investments to be locked in for a certain time period, which might not be a feasible strategy for a salaried middle-income household. Therefore, its low propensity is well justified. But the attractiveness of SIP over VA remains to be investigated.

Actual stock price movements have been captured to obtain realistic outcomes for a VA, as compared to an SIP investor. The difference between the returns was then structured using the value-based version of Multi-Criteria Decision Analysis (MCDA) to rank each stock in terms of their risk-return criteria. A comparative analysis of the ranking of individual stocks based on their efficiency scores provided important insights for mutual funds, financial brokers and individual investors in the Indian capital market. The results establish VA as a viable alternative investment strategy over SIP.

The remainder of the paper is structured as follows. Section 1 gives an overview of SIP and VA investment strategies and reviews the existing literature. Section 2 provides the methodology adopted to calculate excess returns for each strategy and the MCDA approach to ranking individual stocks, while Section 3 discusses the results, describes the dataset and presents the analysis. The last section highlights the limitations of the dataset along with relevant implications for financial planners.

1. LITERATURE REVIEW

SIP is the most popular financial planning and investment strategy due to the ability to lower risk (Constantinides, 1979; Trainor, 2005) and achieve an optimal portfolio according to an investor's risk-return trade-off (Dichtl & Drobetz, 2011). The average cost per share reduces over a period, and investors can cash in capital gains when the market returns to its peak (Cohen et al., 1987; Malkiel, 1999).

Earlier, Statman (1995) used prospect theory to explain that investors want to minimize the regret of losing money owing to their decision to invest in a risky asset. Leggio and Lien (2001) found the highest returns for small-cap stocks under VA, while SIP performed worse for volatile stocks, thereby contradicting Statman's (1995) argument that loss aversion supports SIP. They studied monthly returns for 1926–1999 for US companies and suggested that SIP is a conservative investment strategy that is best suited for investors who seek a forced saving plan to avoid consumption of earnings. Choe and Ban (2020) replicated Leggio and Lien (2001) study for the Korean fund market over an 18-year period and obtained contrasting results, with VA performing the worst in terms of lower returns and higher standard deviation (risk), compared to SIP and Buy-Hold strategy.

Chen and Estes (2007) performed simulations using monthly historic data and showed that VA provided higher terminal value than SIP in the context of a retirement account portfolio. Chen and Estes (2010) extended their earlier study using Monte Carlo simulation whereby VA emerged superior once again, in terms of terminal value, total risk and reward to risk ratio when compared to SIP and proportional rebalancing. In the same strand, Panyagometh (2013) carried out Monte Carlo simulation and Genetic Algorithm-Based Optimization for the Stock Exchange of Thailand and revealed that VA performed better than SIP with an increased time horizon and/or lower target terminal wealth. In another study on the Thailand market, Anantanasuwong and Chaivisuttangkun (2019) found VA and SIP to be inferior to Lumpsum and Asset Allocations strategies, but suitable for a savings plan for managing

money. Further, their study asserted that VA was not an ideal strategy in the short run. A similar time horizon study was also carried out by Širůček and Škatuľárová (2016) where S&P 500 index data was studied from 1990 to 2013 to include the bull and recessionary markets, over 1-year, 5-year and 10-year horizons. VA performed better in all the metrics over a longer time frame such that a 10-year strategy had the lowest annualized risk.

Chopade (2013) studied five Indian mutual funds for the period 2008–2013 and found VA to outperform SIP in terms of Extended Internal Rate of Return (XIRR). On similar lines, Dhar and Banerjee (2021) studied a single mutual fund and found VA to outperform SIP. In contrast, David et al. (2019) compared the performance of five Indian equity-linked mutual funds, where SIP was found to offer the maximum returns, followed by VA and lumpsum investing where return was measured in terms of overall growth in monetary value of the portfolio. Patel and Shinde (2020) also conducted a similar study and observed SIP to provide 5-6% more returns in India compared to other investment options with VA offering the least returns among the strategies. These studies looked into various measures of performance like modified Sharpe Ratio, modified Sortino Ratio, shortfall probability, and dominance probability.

An interesting extension was carried out by Lai et al. (2016) incorporating options to liquidate or inject surplus cash using a bond portfolio and Bollinger Bands (BB) to determine when to enter or exit the market in the VA strategy. 43 exchange-traded funds were simulated from 2003 to 2014 under different market scenarios and across all market capitalization levels (large, mid and small cap funds). VA outperformed SIP in terms of returns, wherein VA returns were better when combined with BB, implying that timing the market using technical analysis would be a value addition to VA investors.

Multi-Criteria Decision Analysis (MCDA) is an extended form used in finance, relating linear programming formulations with partial information on weights (Athanassopoulos & Podinovski, 1997; Gouveia et al., 2008) by converting Data Envelopment Analysis (DEA) inputs and outputs into value functions. According to Glawischnig and Sommersguter-Reichmann (2010), an input is characterized by the variables that an entity (investor) is interested in minimizing (risk measures), while an output would include variables the investor wishes to maximize (return measures). Khedmatgozar et al. (2013) evaluated mutual fund performances using the value efficiency analysis MCDA method where the ranking is incorporated using a virtual efficient frontier having the most desirable values of inputs and outputs. The value based MCDA version was applied by Gouveia et al. (2018) to assess the performance of 15 Portuguese equity funds over 2007–2014.

Following Murthi et al. (1997) who proposed a DEA portfolio efficiency index (DPEI) to compare the performance of different asset classes to capture the risk-return trade off and/or to undertake cost-benefit analysis, Basso and Funari (2001) examined 47 mutual funds and applied DEA using weekly returns against the risk measures of portfolio variance and the beta coefficient. They opined that DEA score can be used to complement traditional metrics like Sharpe ratio, Treynor ratio, and Jensen's Alpha and that the methodology is particularly useful to model conflicting objectives like return on investment and pursuit of social objectives. The Australian mutual funds were studied by Galagedera and Silvapulle (2002) who included the management expense ratio and the minimum initial investment into their calculations. Batra and Batra (2012) found a higher efficiency score for SIP versus a lumpsum investment strategy for a single Indian mutual fund. In line with these studies, the present study incorporates linear programming with value-based DEA to evaluate financial assets from the investor's viewpoint and identify top performers in the Indian equity market that favored VA investment strategy during the 2010–2019 period.

Research on SIP versus VA financial strategy options is sparse, in terms of both sectoral and time horizon analyses. This study fills the lacuna by considering an extensive dataset of the Indian equity market. The study seeks to explore which of the two investment strategies gives higher excess returns over the 3-year, 5-year and 10-year time horizons. Further, this paper applies an efficiency score analysis to rank the individual companies based on risk-return measures across sectors and market capitalizations.

http://dx.doi.org/10.21511/imfi.18(3).2021.04

2. RESEARCH METHODOLOGY

This study assumes that an investor contributes INR 20,000 on the 10th day of every month under SIP for a time horizon of 10 years. The total investment, therefore, would be INR 2,400,000 at the end of the 120th month. There could be some discrepancies, since fractional shares cannot be purchased and investment in certain months might fall below the exact amount of INR 20,000. Under VA, an investor starts with INR 20,000 in the first month and wishes to increase his portfolio value by INR 20,000 every month. However, the actual additional amount of investment each month depends on the market price on that date. Appendix A illustrates three hypothetical scenarios on how SIP and VA strategy work under falling, rising and fluctuating markets. When stock markets keep rising, the actual number of shares purchased will fall in both the investment strategies and the opposite would hold with a declining market. In the SIP, the investor will continue to invest the fixed monthly amount regardless of the stock price, whereas for VA, the investor would adjust his actual monthly investments in line with the movement in the stock price. More importantly, whether the share prices are rising or declining or fluctuating, VA yields a lower average cost of shares purchased than SIP.

Under VA, when the portfolio value reaches the required amount because of a surge in share price in a particular month, the investor does not invest any amount for that month. So, when share prices follow an increasing trend, the portfolio value will exceed the target amount such that the investor would have sufficient amount of surplus cash. Thus a VA investor assumes higher risks with the optimism that their surplus cash could be a reserve to minimize the consequence of larger payments in the future. One could also conclude that VA is more suited for investors who are more vigilant, and have deep pockets to source the extra cash during difficult times.

The ranking of the stocks based on XIRR is inappropriate, since investment is not only about maximizing returns. The risk associated with an investment strategy is of significant concern to investors, considering that there are alternative investment options available in the market. It is particularly imperative to incorporate the risk appetite of a VA investor who has to contribute large sums of money in the declining market scenario to maintain his target portfolio value. So, in addition to the XIRR analysis, an extended value-based form of Data Envelopment Analysis was applied to calculate efficiency scores of individual stocks.

Data envelopment analysis (DEA) calculates relative efficiency of decision-making units (DMUs), allowing for multiple inputs and outputs, and constructs an efficiency frontier (Charnes et al., 1978) and identifies each DMU by choosing its best feasible weights relative to the frontier. Linear programming determines the envelopment surface and provides measures for relative efficiency scores of non-frontier units. In financial analysis, identification of a production process is meaningless and relevant extensions have to be made to incorporate the concepts of inputs and outputs. Hence, Gouveia et al. (2008) developed the value-based DEA following the multi-criteria decision analysis (MCDA) whereby input and output factors are converted into their value functions. This study utilizes the link between DEA and MCDA applied in a real-world situation in which the investors seek to evaluate DMUs taking into account their financial preferences.

Let n denote the number of DMUs using m inputs and producing s outputs. The linear program to be solved for each DMU is:

$$\text{Maximize } z = \sum wk \cdot sk, \text{ where } k = 1,\ldots,q.$$

Subject to

$$\sum Xij \cdot \lambda j + si = xi_0, \text{ where } i = 1,\ldots,m,$$

$$\sum \lambda j \cdot Yrj - \sum Xij \cdot \lambda j \le 0, \text{ where } r = 1,\ldots,s,$$

$$\lambda j,\ sk \ge 0, \text{ where } j = 1,\ldots,n, \qquad (1)$$

where Xij denotes the amount of input i, used by DMU j, where $j = 1,\ldots,n$; Yrj denotes the amount of output r produced by DMU i, where $r = 1,\ldots,s$; λ and w are the respective vector of weights for the inputs and outputs.

The subscript '0' denotes the index of the DMU under consideration. Efficiency for DEA model rang-

es as (0, 1) such that the DMUs having scores of '1' are said to be on the efficiency frontier. Hence, DEA provides a solution by calculating a single measure of efficiency from a given set of inputs and outputs.

Efficiency for an optimal investment strategy involves several risk factors that are of prime importance to the investor. For instance, the total investment required by the VA investor to reach his target portfolio value, the number of times the investor needs to deposit additional funds during declining markets etc. So, the multi-criteria framework extends the basic DEA model to measure efficiency with regard to goals to be minimized versus goals to be maximized. The input and output factors in the model are important to quantify these goals. Further, value-based DEA stipulates that outputs and inputs should be converted into value functions in line with these specific goals. For each DMU, the value obtained in the multiple factors are then aggregated according to the MCDA model where the weights now represent scaling constants that reflect the risk-return trade-offs for the investor.

$$\text{Maximize } v\left(DMUj\right) = \sum wk \cdot vkj. \qquad (2)$$

Subject to

$$\sum vkj \cdot \lambda j - sk = vk_0, \text{ where } j = 1, \ldots, n,$$

$$\sum \lambda j = 1 \text{ and } \lambda j,\ sk \geq 0.$$

So, the relevance of input/output factors in the MCDA depends on the objectives to be pursued by the DMUs. The weights wk are estimated for each unit and interpreted as 'value trade-offs for the client', which differ from one unit to another. It is, therefore, important to derive the objectives to be taken into account and select the factor(s) that would measure performance criteria of the DMUs. These criteria have to be individually determined from the perspective of the evaluators under consideration for a particular study.

3. RESULTS AND DISCUSSIONS

The data has been collected for 359 stocks listed on the National Stock Exchange (NSE) over 120 months, from January 2010 to December 2019. Companies that have been listed post 2010 were excluded from the analysis. This is the most extensive study that seeks to calculate SIP returns and VA returns by using the extended internal rate of return (XIRR) over 3-year, 5-year, and 10-year time periods and for different market capitalizations (small, medium and large cap stocks) across all sectors. The market prices of the shares are the adjusted prices from the Yahoo Finance website. The stocks were segregated into large cap, mid cap and small cap companies, based on their market capitalization (Table 1).

The XIRR function in MS Excel is used to calculate the annual returns of each stock, under the SIP and VA strategies. Excess returns were then calculated as the difference between VA returns and SIP returns, expressed in percentage points (ppt). A transaction cost of 0.1% on the amount invested has been considered when the investment in made under both investment scenarios. The calculated excess returns were then segregated according to market capitalization (Table 2).

Table 2 shows that only seven companies out of 359 in the sample had SIP returns higher than VA returns for the time period under consideration, which included large-cap companies such as Reliance, Bosch, Biocon, and Bajaj Finance. These companies were excluded from the analysis, since DEA does not support negative outputs, and the focus of the study was on the companies where VA returns were superior to the SIP strategy. Further analysis was carried out with 352 companies.

The dataset was further segregated into different time horizons, starting from January 2010, in order to investigate the pattern of excess returns:

Table 1. Sample of stocks listed on the NSE according to market capitalization

Market segmentation	Market capitalization	Frequency	Percent
Large-cap companies	More than INR 300 bn	106	29.53
Mid-cap companies	INR 100 bn to INR 300 bn	91	25.35
Small-cap companies	Less than INR 100 bn	162	45.12
Total		359	100.0

http://dx.doi.org/10.21511/imfi.18(3).2021.04

Table 2. Excess returns (VA XIRR – SIP XIRR) according to market capitalization: Frequency

Market capitalization	< 0 ppt	0 to 3 ppt	3 to 6 ppt	6 to 9 ppt	> 9 ppt	Total
Large-cap companies	4	85	17			106
Mid-cap companies		54	35	2		91
Small-cap companies	3	93	47	18	1	162
Total	7	232	99	20	1	359

3 years – January 2010 to December 2012;
5 years – January 2010 to December 2014;
10 years – January 2010 to December 2019.

Table 3 gives the break-up of the Mean Excess Returns according to market capitalization and according to sectors for each time horizon. No clear pattern or trend was found, in terms of the investment horizon. In the Construction, Consumer Goods and Industrial Manufacturing sectors, the VA strategy yielded consistent higher returns than the SIP across all market capitalization levels and all time horizons.

According to industry experts, investors would ideally seek an excess of 3 percentage points of VA returns over a corresponding strategy, in order to affirm the superiority of the VA option. In line with this benchmark, the focus was on the 120 companies from Table 2, which showed a superiority of VA strategy in the Indian equity market during the 2010–2019 period by yielding excess returns of more than 3 ppt over SIP. Within this set, 17 out of 106 were large cap companies; 37 out of 91 belonged to mid-cap and 66 out of 162 were small-cap companies (Table 4). So, the results clearly indicate that VA worked better for the mid and small cap companies.

Table 4 shows the frequency distribution of the excess returns of VA over SIP of more than 3 ppt. Small-cap companies dominated the VA excess returns having 55 percent of the chosen 120 companies, the top three sectors being Consumers Goods, Industrial Manufacturing and Financial Services. For Consumers Goods and Industrial Manufacturing, the highest returns for VA came from small-cap companies, while for Financial Services the top companies for VA belonged to the mid-range market capitalization.

Next, the top performing stocks for VA strategy were identified in each category of market capitalization. The value-based linear programming mod-

Table 3. Mean excess return (VA XIRR – SIP XIRR), in percentage points according to market capitalization and sectors

Market capitalization	Large-cap companies			Mid-cap companies			Small-cap companies		
	10 years	5 years	3 years	10 years	5 years	3 years	10 years	5 years	3 years
Automobile	2.06	0.78	3.38	3.67	3.68	5.05	2.18	3.07	1.35
Cement	1.87	3.86	1.41	2.34	6.76	4.59	3.39	2.21	2.15
Chemicals	1.01	11.1	0.00	1.55	0.79	2.94	3.07	2.65	2.64
Construction	1.39	4.70	4.22	3.15	2.38	1.79	3.90	3.28	3.63
Consumer Goods	1.77	2.06	2.73	3.01	3.62	2.45	3.89	1.39	1.54
Fertilizers & Chemicals	1.14	2.23	1.99	2.18	3.96	3.15	3.21	2.84	0.40
Financial Services	1.16	2.59	1.16	2.04	3.39	3.15	1.85	1.89	–0.07
Industrial Manufacturing	2.82	3.03	3.50	2.62	3.88	1.58	2.62	2.46	3.15
IT	1.64	5.37	1.96	2.17	2.69	3.80	5.23	0.33	2.77
Logistics	–	–	–	–	–	–	6.49	0.53	1.02
Media & Entertainment	–	–	–	3.93	3.61	2.87	0.65	0.29	1.99
Metals	2.22	2.97	1.65	0.03	1.50	4.33	2.31	1.58	1.67
Oil & Gas	1.39	0.64	4.42	0.85	3.39	3.08	0.00	2.75	4.06
Paper	–	–	–	–	–	–	0.24	4.74	0.00
Pharma & Healthcare	2.13	8.84	5.94	2.62	1.52	1.56	3.59	1.22	2.54
Power	0.40	4.16	11.9	3.43	4.53	5.98	1.17	1.38	0.53
Services	1.52	2.99	2.72	1.05	6.06	1.41	3.28	3.78	1.61
Telecom	2.54	3.99	9.57	0.36	2.60	1.52	3.87	5.57	5.61
Textiles	3.32	0.64	2.41	–	–	–	3.07	0.79	3.85

Table 4. Frequency table for 10-year excess returns > 3 ppt according to market capitalization and sectors

Market capitalization	Large-cap companies	Mid-cap companies	Small-cap companies	Total
Automobile	2	4	3	9
Cement			2	2
Chemicals		1	6	7
Construction		2	6	7
Consumer Goods		7	12	19
Fertilizers & Chemicals		1	3	4
Financial Services	2	9	2	13
Industrial Manufacturing	4	4	8	16
IT	1	1	6	8
Logistics			1	1
Media & Entertainment		2		2
Metals	3		2	5
Oil & Gas	1			1
Paper				
Pharma & Healthcare	2	4	5	11
Power		2		2
Services			5	6
Telecom	1		2	3
Textiles	1		3	4
Total	17 (14.2%)	37 (30.8%)	66 (55.0%)	120

el of DEA-MCDA was employed to obtain the efficiency scores, following Almeida and Dias (2012), Gouveia et al. (2018), and Gouveia and Clímaco (2018). As explained earlier, the value-based DEA model critically depends on identification of the inputs and outputs of the model, since traditional concepts of manufacturing cannot be applied to financial markets. The output factor would be the variable to be maximized, which is the excess return calculated as the XIRR of the VA strategy minus the XIRR of the SIP strategy.

Risk factors for a VA investor was identified as the multi-criteria inputs for the model, which would be the factors to be minimized for the value-based DEA. First, an investor under VA would seek to minimize his total actual investments to achieve his desired target portfolio. Second, the volatility and associated risk of a stock is captured through its standard deviation. Third, a VA investor would stop investments during boom periods, while he would have to put in additional investments when the market declines. This was incorporated into the input factors as the number of times the VA investor had to put in more than INR 20,000 in a particular month during the investment horizon. Finally, since the VA investment strategy is driven by a target portfolio value, an investor would also stop investing when the value exceeds their target, which was calculated as the number of months within which the investor can stop his investments.

These input-output features have been captured in the frontier analysis as follows:

Factors to maximize (output)

1. Excess return – VA XIRR minus SIP XIRR.

Factors to minimize (inputs)

1. VA investment – total amount investment under VA strategy over the time period.
2. Standard deviation – riskiness of the strategy measured by volatility in returns.
3. Stop investment – number of months when the VA investor can stop investing because the portfolio value has exceeded the required amount due to rise in stock prices.
4. > 20K – number of times the VA investor has to be put in more than INR 20,000 during the investment horizon.

http://dx.doi.org/10.21511/imfi.18(3).2021.04

Table 5 gives a comparison of the rankings based on Excess Returns versus the rankings based on the DEA frontier model. The top 10 performers, ranked according to their Excess Returns, listed only small-cap companies, whereas a more realistic evaluation was generated when the risk factors were included into the DEA criteria. Based on the DEA efficiency scores, only four out of the top 10 performers overlapped with the excess returns criteria indicating that the risk factors play a significant role and need to be taken into account when investors weigh their options between their financial planning strategies.

It should be noted here that the excess returns for Vakrangee Ltd. was 12.63%, making it the undisputable winner during the 2010–2019 period for VA investment strategy. However, the risk factors for the investment were very high, since it required 118 months to reach the target portfolio value. As a result, the company does not secure a place in the top 10 performers under the DEA efficiency ranking. Similarly, Indiabulls Real Estate Ltd. required a VA investor to put in more than INR 20,000 into his trading account 16 times during the 10-year time horizon. In contrast, the DEA confers high scores to Tata Communications (large-cap) and Adani Power, Ajanta Pharmaceuticals and Kajaria Ceramics in the mid-cap range.

The dataset was further segregated according to market capitalization (Table 6). In the large-cap company list, majority of the top performing companies overlap in the XIRR and DEA rankings. As

Table 5. Comparison of rankings of highest performing companies

Company classification	Company name	Sector	Market cap	Rank based on	
				XIRR	DEA
All companies (352 obs.)	Vakrangee Ltd.	IT	SMALL	1	
	Symphony Ltd.	Consumer Goods	SMALL	2	1
	Century Plyboards (India) Ltd.	Consumer Goods	SMALL	3	
	Indiabulls Real Estate Ltd.	Construction	SMALL	4	
	Sun Pharma Adv Research Co.	Pharma & Healthcare	SMALL	5	2
	Kaveri Seed Company	Consumer Goods	SMALL	6	3
	Century Textile & Industries	Textiles	SMALL	7	9
	NCC Ltd.	Construction	SMALL	8	
	ITD Cementation India	Construction	SMALL	9	
	eClerx Services Ltd.	IT	SMALL	10	
	Adani Power Ltd.	Power	MID		4
	Tata Communications Ltd.	Telecom	LARGE		5
	Ajanta Pharmaceuticals	Pharma & Healthcare	MID		6
	La Opala RG Ltd.	Consumer Goods	SMALL		7
	Kajaria Ceramics Ltd.	Construction	MID		8
	Shilpa Medicare Ltd.	Pharma & Healthcare	SMALL		10

Table 6. Comparison of rankings of highest performing companies by market capitalization

Company classification	Company name	Sector	Market cap	Rank based on	
				XIRR	DEA
Large-cap companies (102 obs.)	Ashok Leyland Ltd.	Automobile	LARGE	1	
	Aurobindo Pharma Ltd.	Pharma & Healthcare	LARGE	2	2
	Tata Communications Ltd.	Telecom	LARGE	3	1
	Motherson Sumi Systems Ltd.	Automobile	LARGE	4	3
	Cadila Healthcare	Pharma & Healthcare	LARGE	5	4
	Astral Poly Technik Ltd.	Industrial Manufg	LARGE		5
Mid-cap companies (92 obs.)	Adani Power Ltd.	Power	MID	1	1
	Ajanta Pharmaceuticals Ltd.	Pharma & Healthcare	MID	2	2
	Apollo Tyres Ltd.	Automobile	MID	3	
	Amara Raja Batteries Ltd.	Automobile	MID	4	4
	Vaibhav Global Ltd.	Consumer Goods	MID	5	
	Kajaria Ceramics Ltd.	Construction	MID		3
	CRISIL Ltd.	Financial Services	MID		5
Small-cap companies (159 obs.)	Vakrangee Ltd.	IT	SMALL	1	
	Symphony Ltd.	Consumer Goods	SMALL	2	1
	Century Plyboards (India) Ltd.	Consumer Goods	SMALL	3	
	Indiabulls Real Estate Ltd.	Construction	SMALL	4	
	Sun Pharma AdvResearch Co.	Pharma & Healthcare	SMALL	5	2
	Kaveri Seed Company	Consumer Goods	SMALL		3
	La Opala RG Ltd.	Consumer Goods	SMALL		4
	Century Textile & Industries	Textiles	SMALL		5

for the mid-cap company list, there are three companies (Adani Power, Ajanta Pharmaceuticals, and Amara Raja Batteries) on both rankings. In contrast, for small-cap companies, there is a notable difference in the rankings, since only Symphony and Sun Pharma appear in both the ranking lists. This indicates that the higher the market capitalization, the lower the risks involved, so the companies yielded similar VA efficiency scores for XIRR and DEA calculations.

CONCLUSION

The aim of the study was to explore the overwhelming popularity of SIP as the dominant investment strategy applied in the Indian investment landscape and further provide empirical evidence in favor of VA as a viable investment strategy compared to SIP. To this end, 359 stocks from the Indian equity market were studied for the period 2010–2019, across different time horizons, market capitalizations and sectoral classifications.

The results show that in terms of market returns based on XIRR, VA outperformed SIP as an investment strategy in 352 out of 359 companies during the last decade. Based on the industry benchmark for a 3 percentage point excess of VA returns over the corresponding SIP strategy, 120 companies (out of 359) were deemed superior for VA, with a clear dominance of small-cap companies. The top three sectors favoring the VA strategy were Consumers Goods, Industrial Manufacturing and Financial Services. The empirical findings make an important contribution to the Indian equity market by establishing the superiority of VA as a profitable investment strategy over SIP and by giving clear strategic directions for VA investors.

The value-based DEA efficiency scores highlight that risk factors (total investments under VA, standard deviation of VA strategy, months to stop investing and investment of more than INR 20,000 during phases of declining markets) should be taken into account rather than base investment decisions only on the excess returns criteria, since there were significant differences in the rankings under XIRR and DEA. Higher market capitalization was associated with lower risks of market volatility, so that large-cap companies yielded similar VA efficiency scores for XIRR and DEA calculations, while there were clear divergences between the top performers among small cap companies.

This study is of particular interest to individual investors and portfolio managers, since VA has been a less explored option, particularly in the Indian context. The findings shed light on VA – this is an expedient investment approach that should be explored to create a diversified portfolio. In reality, an investor will not hold a stock under VA for 10 years if the expected portfolio value has been achieved in a shorter time frame. Thus, if no additional investment is required, although XIRR returns might be superior under VA, the strategy will yield lower investor wealth than SIP. Therefore, once the expected portfolio returns are achieved, the VA investor should either choose to diversify (select another stock) or move to SIP for the same stock to achieve higher wealth.

It should be noted that the study results were based solely on historical stock market data over the last decade, with the 3-year and 5-year time horizons being considered from January 2010. Rolling returns were calculated for 3-year and 5-year periods for the Nifty market index (top 50 stocks of National Stock Exchange), starting from 2010, 2011 and so on, and no significant deviations were found in the results. A limitation of this study might be the time period under consideration, since for stocks that are more volatile than the index, the results might be different for different starting points. Further research can be done by calculating excess returns for different time periods to confirm the validity and robustness of the findings. Since the study is exclusively based on stock prices, the sectoral and market cap findings could be extended to assets with similar risk profiles. The DEA technique used in this study can be replicated in international stock markets to create portfolios based on the investor's risk-return preferences. Moreover, efficiency scores could be further explored by considering market and firm specific variables.

http://dx.doi.org/10.21511/imfi.18(3).2021.04

AUTHOR CONTRIBUTIONS

Conceptualization: Nandan Bendarkar.
Data curation: Rashita Puthiya, Nandan Bendarkar.
Formal analysis: Sudipa Majumdar, Rashita Puthiya.
Methodology: Sudipa Majumdar.
Validation: Nandan Bendarkar.
Writing – original draft: Rashita Puthiya, Sudipa Majumdar.
Writing – review & editing: Rashita Puthiya, Sudipa Majumdar.

REFERENCES

1. Almeida, P. N., & Dias, L. C. (2012). Value-based DEA models: application-driven developments. *Journal of the Operational Research Society, 63*(1), 16-27. https://doi.org/10.1057/jors.2011.15
2. Anantanasuwong, K., & Chaivisuttangkun, S. (2019). Do Investors Benefit from DCA? Evidence from the Stock Exchange of Thailand. *Chulalongkorn Business Review, 41*(2), 84-101.
3. Athanassopoulos, A. D., & Podinovski, V. V. (1997). Dominance and potential optimality in multiple criteria decision analysis with imprecise information. *Journal of the Operational Research Society, 48*(2), 142-150. https://doi.org/10.2307/3010354
4. Basso, A., & Funari, S. (2001). A data envelopment analysis approach to measure the mutual fund performance. *European Journal of Operational Research, 135*(3), 477-492. https://doi.org/10.1016/s0377-2217(00)00311-8
5. Batra, D., & Batra, G. (2012). A DEA comparison of systematic and lump sum investment in mutual funds. *International Journal of Computing Business Research, 3*(2), 1-10.
6. Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research, 2*(6), 429-444. https://doi.org/10.1016/0377-2217(78)90138-8
7. Chen, H., & Estes, J. (2007). Value Averaging for 401(k) Plans Makes More "Cents" than Dollar-Cost Averaging. *Journal of Financial Planning, 20*(2), 56-59.
8. Chen, H., & Estes, J. (2010). A Monte Carlo study of the strategies for 401 (k) plans: dollar-cost-averaging, value-averaging, and proportional rebalancing. *Financial Services Review, 19*(2), 95.
9. Choe, H., & Ban, J. I. (2020). Does Value Averaging Strategy Improve Investment Performance? Evidence from the Korean Fund Market. *Korean Journal of Financial Studies, 49*(3), 313-340. https://doi.org/10.26845/kjfs.2020.06.49.3.313
10. Chopade, C. (2013). An Empirical Study of Value Averaging Vs. Cost Averaging Using Diversified Equity Funds in India. *Quantum, 17,* 12-34.
11. Cohen, J. B., Zinbarg, E. D., & Zeikel, A. (1987). *Investment analysis and portfolio management.* McGraw-Hill/Irwin.
12. Constantinides, G. M. (1979). A note on the suboptimality of dollar-cost averaging as an investment policy. *The Journal of Financial and Quantitative Analysis, 14*(2), 443-450. https://doi.org/10.2307/2330513
13. Dhar, P., & Banerjee, S. (2021). Does Value Averaging Score Over Rupee Cost Averaging?: Rupee Cost Averaging. *Asia-Pacific Journal of Management and Technology, 1*(3), 29-33. https://doi.org/10.46977/apjmt.2021v01i03.005
14. Damodaran, A. (2012). *Investment philosophies: successful strategies and the investors who made them work.* John Wiley & Sons.
15. David, J., Purswani, G., & Jojo, A. (2019). *A study of investment decisions based on systematic investment plan, value averaging and lump-sum investment plan.* Retrieved April 19, 2021, from www.semanticscholar.org
16. Dichtl, H., & Drobetz, W. (2011). Dollar-Cost Averaging and Prospect Theory Investors: An Explanation for a Popular Investment Strategy. *Journal of Behavioral Finance, 12*(1), 41-52. https://doi.org/10.1080/15427560.2011.555029
17. Gouveia, M. D. C. B., Neves, E. D., Dias, L. C., & Antunes, C. H. (2018). Performance evaluation of Portuguese mutual fund portfolios using the value-based DEA method. *Journal of the Operational Research Society, 69*(10), 1628-1639. https://doi.org/10.1057/s41274-017-0259-7
18. Edelson, M. E. (2006). *Value averaging: The safe and easy strategy for higher investment returns.* John Wiley & Sons.
19. Galagedera, D. U., & Silvapulle, P. (2002). Australian Mutual Fund Performance Appraisal Using Data Envelopment Analysis. *Managerial Finance, 28*(9), 60-73. https://doi.org/10.1108/03074350210768077
20. Glawischnig, M., & Sommersguter-Reichmann, M. (2010). Assessing the performance of alternative investments using non-parametric efficiency measurement approaches: Is it convincing? *Journal of Banking*

& Finance, 34(2), 295-303. https://doi.org/10.1016/j.jbankfin.2009.07.017

21. Gouveia, M. C., & Clímaco, I. (2018). Assessment of Fuel Tax Policies to Tackle Carbon Emissions from Road Transport – An Application of the Value-Based DEA Method Including Robustness Analysis. In *Energy Management – Collective and Computational Intelligence with Theory and Applications,* 167-191. https://doi.org/10.1007/978-3-319-75690-5_9

22. Gouveia, M. C., Dias, L. C., & Antunes, C. H. (2008). Additive DEA based on MCDA with imprecise information. *Journal of the Operational Research Society, 59*(1), 54-63. https://doi.org/10.1057/palgrave.jors.2602317

23. Khedmatgozar, H. R., Kazemi, A., & Hanafizadeh, P. (2013). Mutual fund performance evaluation: a value efficiency analysis approach. *International Journal of Electronic Finance, 7*(3/4), 263-280. https://doi.org/10.1504/ijef.2013.058599

24. Lai, H.-C., Tseng, T.-C., & Huang, S.-C. (2016). Combining value averaging and Bollinger Band for an ETF trading strategy. *Applied Economics, 48*(37), 3550-3557. https://doi.org/10.1080/00036846.2016.1142653

25. Leggio, K., & Lien, D. (2001). Does loss aversion explain dollar-cost averaging? *Financial Services Review, 10*(1-4), 117-127. https://doi.org/10.1016/s1057-0810(02)00090-2

26. Malkiel, B. G. (1999). *A random walk down Wall Street: including a life-cycle guide to personal investing.* WW Norton & Company.

27. Murthi, B. P. S., Choi, Y. K., & Desai, P. (1997). Efficiency of mutual funds and portfolio performance measurement: A non-parametric approach. *European Journal of Operational Research, 98*(2), 408-418. https://doi.org/10.1016/s0377-2217(96)00356-6

28. Panyagometh, K. (2013). Performance Comparison between Dollar Cost Averaging and Value Averaging Investment Strategies and the Impacts of Investment Horizon and Target Terminal Wealth. *Journal of Applied Finance & Banking, 3*(3), 15-27.

29. Patel, P., & Shinde, S. (2020). A study to find the best alternative for maximum returns on Mutual Funds using Systematic Investment Plan, Lump-sum & Value Averaging Investment method. *International Journal of Scientific and Engineering Research, 11*(10), 1065-1079.

30. Širůček, M., & Škatuľárová, I. (2016). Application of the Value Averaging Investment Method on the US Stock Market. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis, 63*(6), 2151-2160. https://doi.org/10.11118/201563062151

31. Shenoy, D. (2021). OMG: The Retail Investor is the Biggest Player in the Stock Market. *Capitalmind*. Retrieved from https://www.capitalmind.in/2021/05/omg-the-retail-investor-is-the-biggest-player-in-the-stock-market/

32. Statman, M. (1995). A Behavioral Framework for Dollar-Cost Averaging. *The Journal of Portfolio Management, 22*(1), 70-78. https://doi.org/10.3905/jpm.1995.409537

33. Trainor, W. J. (2005). Within-horizon exposure to loss for dollar cost averaging and lump sum investing. *Financial Services Review, 14*(4), 319-330.

http://dx.doi.org/10.21511/imfi.18(3).2021.04

APPENDIX A

Table A1. Systematic Investment Planning (SIP) and Value Averaging (VA). Illustration of the Systematic Investment Plan – a hypothetical example with three market scenarios, where a fixed amount of INR 20,000 is invested for four months under SIP

Months	Stock price (INR)	Planned investment (INR)	Shares purchased	Average cost (INR)
Rising market				
1	5	20,000	4000	
2	8	20,000	2500	
3	10	20,000	2000	7.92
4	12.5	20,000	1600	
Total		80,000	**10,100**	
Declining market				
1	12.5	20,000	1600	
2	10	20,000	2000	
3	8	20,000	2500	7.92
4	5	20,000	4000	
Total		80,000	**10,100**	
Fluctuating market				
1	5	20,000	4000	
2	8	20,000	2500	
3	8	20,000	2500	6.15
4	5	20,000	4000	
Total		80,000	**13,000**	

Table A2. Illustration of the Value Averaging Strategy – similar market scenarios under the VA strategy, wherein the investor seeks a monthly increase of INR 20,000 in the portfolio value

MONTHS	STOCK PRICE (INR)	PLANNED PORTFOLIO (INR)	SHARES TO BE OWNED	SHARES BOUGHT	ACTUAL INVESTMENT (INR)	Average Cost (INR)
Rising market						
1	5	20,000	4000	4000	20,000	
2	8	40,000	5000	1000	8,000	
3	10	60,000	6000	1000	10,000	6.72
4	12.5	80,000	6400	400	5,000	
Total				6,400	**43,000**	
Declining market						
1	12.5	20,000	1600	1600	20,000	
2	10	40,000	4000	2400	24,000	
3	8	60,000	7500	3500	28,000	7.16
4	5	80,000	16,000	8500	42,500	
Total				16,000	**114,500**	
Fluctuating market						
1	5	20,000	4000	4000	20,000	
2	8	20,000	5000	1000	8,000	
3	8	20,000	7500	2500	20,000	5.66
4	5	20,000	16000	8500	42,500	
Total				16,000	**90,500**	