

Does Dollar Cost Averaging Make Sense For Investors? DCA's Benefits and Drawbacks Examined

Dollar Cost Averaging (DCA) is a strategy recommended by many professional money managers as a means of gradually investing a lump sum of money in a conservative fashion. But do DCA strategies perform better than a simple lump-sum investment? Are there variations of DCA strategies that provide incremental value to a portfolio?

Abstract

In the wake of increased volatility and two equity market crashes over the last decade, a growing number of investors have become wary of putting large blocks of cash to work in the market all at once. Instead, they invest smaller amounts of cash at regular intervals over an extended period of time. This process is called dollar cost averaging (DCA), a strategy often recommended by investment advisors for risk-averse clients. But does this strategy have any investment merit or is it done primarily to allay the fears of investors?

In addition to comparing the historical performance of DCA with a regular lump-sum investing strategy, this paper also looks at variations of the basic DCA strategy to see if they entail any added benefit. The variations of regular DCA strategies analyzed have been termed ‘value averaging’ (value DCA) and ‘momentum averaging’ (momentum DCA). Both strategies involve adjusting the amount of money invested on a monthly basis, up or down, relative to regular DCA, based on the previous month’s return. In the case of value DCA, more is invested if the market has gone down in a pre-specified trailing time period and less is invested when the market has previously gone up. In the case of momentum DCA, less is invested if the market has gone down in a pre-specified trailing time period and more is invested when the market has previously gone up. In addition to determining the relative merits of these strategies, the paper also analyzes their returns during bull and bear markets.

Background

Dollar cost averaging (DCA) is a strategy with which investors gradually put money to work in the market by investing a set amount at a certain frequency (typically monthly). The idea behind DCA is to buy less when prices

are high and buy more when prices are low. Malkiel (1) stated this principle in his seminal book, *A Random Walk Down Wall Street*:

Periodic investments of equal dollar amounts in common stocks can substantially reduce (but not avoid) the risks of equity investment by insuring that the entire portfolio of stocks will not be purchased at temporarily inflated prices. The investor who makes equal dollar investments will buy fewer shares when prices are high and more shares when prices are low.

The reason why an investor is able to buy more when prices are low and less when prices are high can be explained by the following equation:

$$\text{Number of Shares Purchased} = \frac{\text{Dollar Amount Invested}}{\text{Price per Share}}$$

Since the same dollar amount is being invested each month, if prices go up, an investor buys fewer shares of the market. Similarly, if prices go down, an investor buys more shares. This strategy hence forces investors to buy more at lower prices and less at higher prices. In effect, it is a variation of a value strategy. In times of higher volatility, one expects the markets to zigzag. These up-down jumps allow the DCA strategy to serve its purpose; i.e., buy more at lower prices and less at higher prices.

So when will this strategy not work? This strategy will not do what it’s supposed to do if, over the investor’s DCA horizon, the markets, in general, move up. In this case, there is little or no opportunity to buy low. Since markets are moving up, every time more cash is invested, it is being invested at a higher cost. On the flip side, this strategy will work extremely well over the long run if markets are constantly moving downward. In this case, every new purchase is made at a lower cost than the previous one.

Given that we know when DCA would work and when it wouldn't, it's intuitive to think that a DCA strategy would, more often than not, *not* serve its purpose. This is because we expect that, in general, markets move up; the S&P yielded positive returns in over 60% of the months between January 1, 1926 to December 31, 2010 and in over 70% of the years between 1926 and 2010. However, intuition is not enough to validate the claim that lump-sum investing strategies (investing all available investable assets at once) do better than DCA strategies. Several studies provide statistical and empirical evidence supporting the underperformance of DCA (see box below). Additional research conducted by Gerstein Fisher confirms that DCA strategies underperform lump-sum (LS) investing the majority of the time.

Over the last few decades, several research articles have been published outlining the pros and cons of DCA.

- In 1979, George M. Constantinides (2) theoretically demonstrated the sub-optimality of DCA strategies.
- Rozeff (3) used empirical data to show that LS investing is mean-variance superior to DCA even after holding risk constant for the two strategies (if the market has an expected positive risk premium). Rozeff showed that the LS strategy provided a one to four percent higher annualized return relative to DCA.
- Leggio and Lien (4) went a step further by using prospect theory to explain the role of DCA strategies. Expected utility theory states that investors are risk averse and have a strictly concave utility function. In prospect theory, the utility function is S-shaped with the concave part representing the utility function for gains and the convex part representing the utility function for losses. Additionally, prospect theory utility function states that investors respond to losses in a more extreme manner in comparison to an equivalent gain. Even after accounting for a utility function that wasn't strictly concave, Leggio and Lien showed that DCA strategies are inferior to LS investing. Additionally, and surprisingly, DCA strategies fared worse for more volatile equities, like small-cap stocks, than they did for less volatile equities, such as large-cap stocks. This was evidence against the base case of DCA; i.e., that it's more effective during volatile time periods and for volatile asset classes.

DCA vs. Lump-Sum Investing

To compare performance, the two strategies were back-tested between January 1, 1926 and December 31, 2010. The initial portfolio was assumed to be \$1,000,000 in cash and the only investment available was the S&P 500 index.

The difference between the two strategies regarding how and when the money was invested in the market index is explained below:

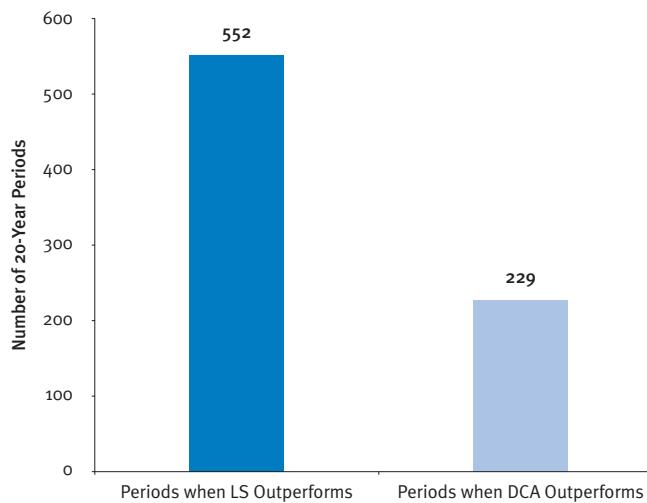
- **DCA Strategy:** 1/12th of the initial portfolio was invested each month, at the beginning of the month. This meant that the entire \$1,000,000 was invested by the end of the 11th month (i.e., by the beginning of the 12th month).
- **Lump-Sum Strategy:** The entire \$1,000,000 portfolio was invested at the beginning of the 1st month (the portfolio was completely invested by day 1).

For the purposes of this study, we assumed zero transaction costs. This assumption favors the DCA strategy since, by design, the DCA strategy involves much more trading, which results in higher transaction costs. The objectives of this back-test were twofold:

1. Identify which strategy was historically superior by comparing portfolio values at the end of the 12th month for each such 12-month period considered. The returns for each strategy were computed for 1,009 such 12-month periods between January 1, 1926 and December 31, 2010.
2. Calculate the average difference between the dollar amounts of the two strategies for a 20-year investment period (inclusive of the first 12 months). For each 12-month period considered in Part 1, a corresponding 20-year investment period was considered, if applicable. After the end of the first year, both the DCA and LS strategy were fully invested in the S&P 500 Index for the next 19 years. There were a total of 781 such periods with the first 20-year period starting in January 1, 1926 and the last 20-year period starting in January 1, 1991.

For the purposes of identifying which strategy performed better historically, a binary system of assigning success was used. If the DCA strategy had a greater ending portfolio value compared to the LS strategy by the end of the 12th month, it was assigned a '1' for that period and the LS strategy was assigned a '0'. Similarly, if the DCA strategy had a lower ending portfolio value compared to the LS strategy by the end of the 12th month, it was assigned a '0' for that period and the LS strategy was assigned a '1'. This methodology was repeated for every rolling 12-month period between January 1, 1926 and December 31, 2010 that had a corresponding 20-year period and the numbers of '1's were aggregated for each strategy. The results of this part of the study are presented in Exhibit 1 on the next page.

Exhibit 1: Historical Success Rates: LS vs. DCA



As can be seen in Exhibit 1, LS investing outperformed the DCA strategy in 552 out of the 781 periods (71% of the time). Nearly three out of four times, one would have been better off investing a lump sum as opposed to using a DCA strategy.

On average, at the end of a 20-year period, an investor who chose the LS strategy would have had \$439,019 more than an investor who chose the DCA strategy. The average ending dollar amounts over 12-month and 20-Year rolling periods for both the LS and the DCA strategy can be seen in Exhibit 2. Since the strategies are fully invested by the end of the first year, both strategies have the same exact returns from Year 2 through Year 20. All of the outperformance is a result of the difference between the strategies during the first year; during this first year, the LS strategy is fully invested and the DCA strategy is gradually invested. On average, over a 12-month rolling period (that had a corresponding 20-year period), LS outperformed DCA by \$60,292. The \$439,019 average difference at the end of the 20 years corresponds to this average difference of \$60,292 obtained at the end of the first year. Exhibit 3 shows a 12-month period (from July 1, 1978 through June 30, 1979) that had a 12 month outperformance of \$61,347. This can be viewed as an approximation of the difference in performance between LS and the DCA strategy.

Exhibit 2: Average Ending Amounts for LS and DCA (Jan. 1, 1926-Dec. 31, 2010)

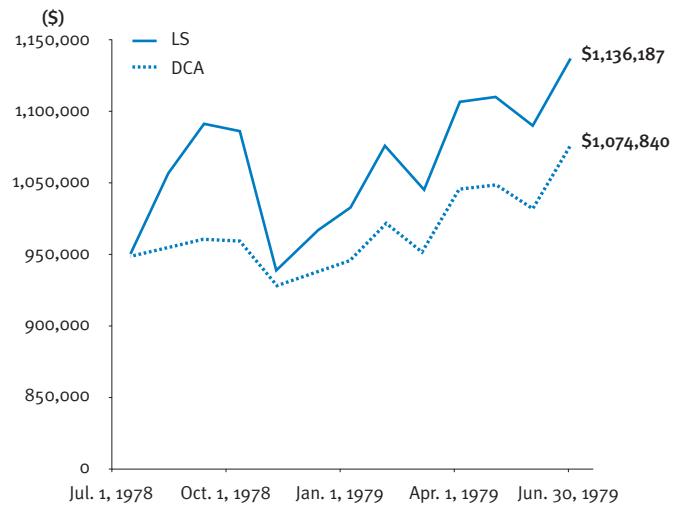
Rolling 12-Month Periods (That had a Corresponding 20 Year Period)

Average Ending DCA Amount	\$1,067,469
Average Ending LS Amount	\$1,127,762
Average Outperformance of LS Over DCA	\$60,293

Rolling 20 Year Periods

Average Ending DCA Amount	\$9,623,006
Average Ending LS Amount	\$10,062,025
Average Outperformance of LS Over DCA	\$439,019

Exhibit 3: Growth of Wealth: Representative 12-Month Period



It is interesting to note that in the instances in which DCA outperformed LS (approximately 30% of the time), the magnitude of that outperformance was less than when LS outperformed DCA. Specifically, during the 552 20-year periods in which LS did better than DCA, the average cumulative outperformance was \$940,301 on our initial \$1 million investment. During the 229 periods in which DCA did better than LS, the average cumulative outperformance was \$769,311. (See Exhibits 4 and 5 on the next page.)

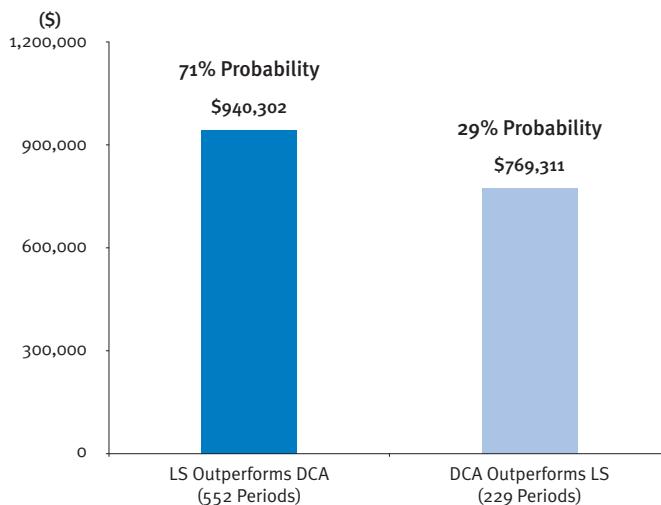
Exhibit 4: Periods of LS and DCA Outperformance (Rolling 20-Year Periods, Jan. 1, 1926-Dec. 31, 2010)

Periods in Which LS Outperformed DCA

Initial Investment Amount	\$1,000,000
Number of Periods	552
Average Ending DCA Amount ¹	\$9,401,342
Average Ending LS Amount ¹	\$10,341,644
Average Outperformance of LS Over DCA ¹	\$940,302

Initial Investment Amount	\$1,000,000
Number of Periods	229
Average Ending DCA Amount ²	\$10,157,320
Average Ending LS Amount ²	\$9,388,009
Average Outperformance of DCA Over LS ²	\$769,311

Exhibit 5: Relative Outperformance: Rolling 20-Year Periods



The lower frequency of DCA outperformance coupled with a lesser magnitude of outperformance resulted in the figure we noted earlier: average 20-year outperformance of LS over DCA of \$439,019.

To arrive at these numbers, we can look at the two options an investor has:

- a) Lump-sum Investing: 71% probability of doing \$940,302 better
= ‘Probability of LS outperforming DCA’ x ‘Outperformance of LS given that LS outperforms DCA’

$$\begin{aligned}
 &= 70.68\% \times \$940,302 \\
 &= \$664,605 \text{ better}
 \end{aligned}$$

- b) DCA Investing: 29% probability of doing \$769,311 better
= ‘Probability of DCA outperforming LS’ x ‘Outperformance of DCA given that DCA outperforms LS’
= 29.32% x \$769,311
= \$225,652 better

We then combine a) and b) in the following equation to determine expected outperformance of the LS strategy over the DCA strategy:

$$\begin{aligned}
 E[OP] &= Prob(LS > DCA) \times (OP_{LS} | LS > DCA) - \\
 &\quad Prob(DCA > LS) \times (OP_{DCA} | DCA > LS) \\
 &= (70.68\%) \times (\$940,302) - (29.32\%) \times (\$769,311) \\
 &= \$439,043^3 \text{ cumulative over a 20-year period}
 \end{aligned}$$

While these findings make a compelling case for a lump-sum approach over the long term, how do the results compare over a shorter, more recent time period? We ran the same analysis for rolling 12-month periods over the decade between January 2001 and December 2010, when the S&P returned a mere 1.41% annualized, with significant volatility along the way.

The results are summarized in Exhibit 6 below.

Exhibit 6: LS vs. DCA (Rolling 12-Month Periods, Jan. 1, 2001-Dec. 31, 2010)

Initial Investment Amount	\$1,000,000
Number of Periods	109
Number of Periods LS > DCA	70
Average Ending DCA Amount	\$1,020,569
Average Ending LS Amount	\$1,033,416
Average Outperformance of LS Over DCA	\$12,847

As Exhibit 6 shows, even over this “lost decade” for the equity markets, LS still beat DCA approximately 64% of the time. As seen in the last line of Exhibit 6, an investor would have ended up with an incremental \$12,847 (on an initial investment of \$1,000,000) with LS than he or she would have using a DCA approach over this period.

¹ In periods in which LS outperformed DCA

² In periods in which DCA outperformed LS

³ This figure differs slightly from the cumulative outperformance number stated previously due to rounding the probability and outperformance numbers in the calculations above.

Exhibit 7 breaks down the 109 rolling periods into a) the 70 periods in which LS outperformed DCA and b) the 39 in which DCA outperformed LS and examines the magnitude of average outperformance in each case. Exhibit 8 presents a summary of the data from Exhibit 7.

Exhibit 7: Periods of LS and DCA Outperformance (Rolling 12-Month Periods, Jan. 1, 2001-Dec. 31, 2010)

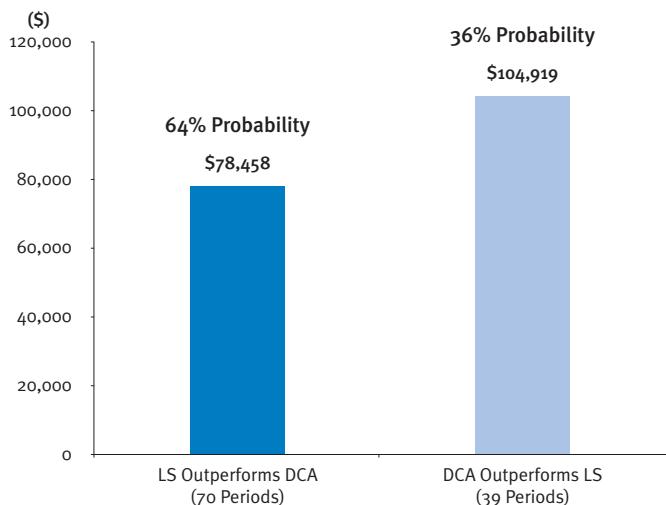
Periods in Which LS Outperformed DCA

Number of Periods	70
Average Ending DCA Amount ⁴	\$1,070,046
Average Ending LS Amount ⁴	\$1,148,504
Average Outperformance of LS Over DCA ⁴	\$78,458

Periods in Which DCA Outperformed LS

Number of Periods	39
Average Ending DCA Amount ⁵	\$931,765
Average Ending LS Amount ⁵	\$826,846
Average Outperformance of DCA Over LS ⁵	\$104,919

Exhibit 8: Relative Outperformance by Strategy: Rolling 12-Month Periods



Although the margin of outperformance of DCA over LS was greater over this 10-year period (\$104,919 versus \$78,458) it was not great enough to compensate for the fact that an investor would only experience such returns approximately 36% of the time. In short, and consistent with results from our earlier analysis going back to 1926, LS was still the superior choice during this “lost decade”.

It is also interesting to note that over the 70 periods in which LS outperformed DCA, there were only four in which the S&P 500 had a negative return over the same period. And in the 39 periods in which DCA outperformed LS, there were only five in which the S&P 500 had a positive return over the same period. These observations reinforce the notion that DCA tends to perform better when markets are going down and LS when markets are going up.

Nonetheless, there is a general misconception among many investment professionals that DCA is a superior investment strategy in terms of returns. Our research, in addition to several prior studies (see box on page 2), has shown that this is in fact not the case. If not, then why is DCA still a popular investment strategy? One explanation may be investors’ aversion to risk. DCA strategies do result in lower volatility. This is a direct function of the assets staying in cash (little to no volatility) for a longer period of time. However, if the long-term asset allocation for an investor suggests a target equity level of ‘x’ percent, is it still appropriate to invest small portions of capital until the investor reaches the target equity allocation of ‘x’? The answer, according to Thorley (5), is no. His research suggests that a buy-and-hold strategy (BH), which would hold the target risky asset allocation of ‘x’ percent from day 0, results in higher expected returns and lower risk compared to a DCA strategy.

Given that the majority of academic and industry research shows the inferiority of DCA strategies (both in terms of risk and return) when compared to LS investing and BH investing, is there any rationale for investors to feel more comfortable using a DCA strategy? Leggio and Lien (4) shed some light on this question. They suggest that DCA is a conservative investment strategy that is best suited for investors who seek a forced saving plan that will ensure that they avoid consumption of earnings. Statman (6) uses Tversky’s and Kahneman’s prospect theory to explain the behavioral preference of investors for DCA. Statman believes that investors want to minimize the regret of losing money stemming from their decision to invest in a risky asset. Statman argues that, by using a DCA strategy, investors feel removed from part of the responsibility of bad investment outcomes. The possible explanations for the use of DCA strategy seem to relate to the irrationality of investors.

⁴ In periods in which LS outperformed DCA

⁵ In periods in which DCA outperformed LS

And even DCA investors are not immune to behavioral tendencies that, if unchecked, could sabotage their strategy. The phenomenon of loss aversion often makes DCA investors want to abandon their periodic investments when markets are going down. Many times, there is a desire to wait until they break even on their first-month investment before they invest any more capital. Ironically, it is at precisely these moments that the opportunity for future returns is greatest.

Although it is easy to discount the DCA strategy on the basis of rationality, it is just as hard for investors to change their behavior. Instead of completely discarding the DCA strategy, Gerstein Fisher researched alternatives that may satisfy the behavioral aspects of investors while improving the expected risk/return of their investment strategy.

Variations to the DCA Strategy

For the purpose of referencing, we will call the DCA strategy described in the previous section (titled ‘DCA vs. Lump-Sum Investing’) as ‘basic DCA’. Gerstein Fisher tested two variations of the basic DCA strategy. The variations tested were in terms of the dollar amount invested each month based on the return of the market in the previous month. The two variation strategies are described below:

- **Value DCA:** In this strategy, more money was invested in months following a month with negative returns and less money was invested in months following a month with positive returns. It has been termed a value strategy since an investor would be investing more after markets have gone down and less when markets go up.
- **Momentum DCA:** In this strategy, less money was invested in months following a month of negative returns and more money was invested in months following a month of positive returns. It has been called a momentum strategy since more is invested after markets go up and less is invested after markets go down.

The amount of variation in the amount invested was based on the ‘variance factor’, a predetermined percentage used to change the amount invested. In our tests, we used a variance factor of 20%. This means that instead of investing 1/12th of the portfolio, which is \$83,333, either \$100,000 ($\$83,333 + 20\% \times \$83,333$) or \$66,666 ($\$83,333 - 20\% \times \$83,333$) was invested in each month depending on the type of variation strategy (either momentum or value) and the return of the previous month (either positive or negative). By investing amounts greater and less than 1/12th of the portfolio, there was a difference in the time period over which the money was invested as compared to the 12-month period for the basic DCA. The theoretical minimum number of months over which the amount was invested was by the beginning of the 10th month: \$100,000 would be invested each month for a period of 10 months. The theoretical maximum number of months over which the amount was invested was by the beginning of the 15th month: \$66,666 would be invested each month for a period of 15 months. The summary of these strategies is presented in the Assumptions Table below.

Without looking at empirical results, it is intuitive to see that the momentum variation would be a better choice if return were the only criteria. As seen previously, lump-sum investing outperformed the basic DCA strategy in terms of return. The rationale behind this was that markets, in general, go up and LS investing has a greater amount invested over a longer period of time relative to the basic DCA strategy. Since markets tend to go up more often than not, the momentum DCA would have more invested compared to the basic DCA strategy. And since more is invested for a greater period of time, momentum DCA can be expected to outperform a basic DCA. The value DCA would result in the exact opposite outcome. Since markets tend to go up more often than not, less

Assumptions Table

	Basic DCA	Value DCA	Momentum DCA
Total Amount Invested	\$1,000,000	\$1,000,000	\$1,000,000
Funding Period (months)	12	10-15	10-15
DCA Variance Factor (%)	N/A	20	20
Investment Period (years)	20	20	20
Amount Invested Each Month	\$83,333	Min: \$66,666 Max: \$100,000	Min: \$66,666 Max: \$100,000

would be invested in a value DCA compared to a basic DCA. Since less is invested for a greater period of time, we can expect the value DCA to underperform basic DCA. The empirical results comparing the basic DCA with its two variations are provided below.

Exhibit 9: Periods of Value and Momentum DCA Outperformance (Rolling 20-Year Periods, Jan. 1, 1926-Dec. 31, 2010)

S&P 500 (Jan. 1926-Dec. 2010)	Value DCA	Momentum DCA
Number of Rolling 20-Year Periods	780	780
Number of Periods	356	425
Strategy > Regular DCA		
Average 20-Year Outperformance of Strategy	-\$29,558	\$20,650

As can be seen, the momentum DCA outperformed the basic DCA in 425 of the 780 periods. In other words, approximately 54% of the time, an investor who chose the momentum DCA achieved better returns than the investor who chose the basic DCA. On the contrary, an investor who chose the value DCA outperformed the basic DCA strategy approximately 46% of the time. Over the average 20-year period, the momentum DCA strategy outperformed the DCA strategy by ~\$20,000, whereas the value DCA strategy lagged the basic DCA strategy by ~\$30,000. Since the momentum DCA strategy is closer to LS investing than is the basic DCA, it is expected to outperform the basic DCA strategy. Similarly, the value DCA strategy is farther from LS investing than the basic DCA, and is thus expected to underperform the basic DCA strategy.

Conclusion

DCA has been a popular investment strategy with individual investors and is still recommended by many investment professionals. Although theoretical and empirical data demonstrate the inferiority of DCA investing compared to LS investing and BH strategies, it is important to understand the underlying reasons that cause investors to choose DCA and investment professionals to recommend DCA. Risk-averse investors, who may be unwilling to invest into risky assets all at once, find the piecemeal approach of DCA strategies emotionally comforting. Investment professionals such as financial advisors find DCA to be an easy way of essentially forcing investors to save. This results in greater expected future wealth for the investors. Given that it's the concept of DCA (rather than the result) that investors and professional still find useful, a better variation of such a strategy has been described.

Gerstein Fisher research has shown that using the momentum DCA approach, which involves investing more or less than the basic DCA depending on whether the market went up or down, respectively, in the previous month, results in higher returns as compared to the basic DCA. Momentum DCA is grounded in the same notion of piecemeal investing that investors find appealing, but has a slight variation that improves expected return. Though this is by no means an optimal solution, this small deviation from the basic DCA may be considered a significant step in reconciling rational investing principles with irrational investor behavior.

Works Cited

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