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 allocating an investor's portfolio into risky assets such as equities to avoid the perceived risk of investing at the "wrong" time. But do DCA strategies perform better than simple lump-sum investing?

Abstract

Given the long-term bull market and high equity valuations, 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? This paper compares the historical performance of DCA with a lump-sum investing strategy where the portfolio allocation into stocks is made at a single point in time.

Background

Dollar-cost averaging 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 fewer shares when prices are high and 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:

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

Since the same dollar amount is being invested each month, if prices go up, an investor buys fewer shares of securities. Similarly, if prices go down, an investor buys more shares. In effect, it is a variation of a value strategy. In times of higher volatility, one expects the markets to zigzag, with stock prices swinging more than in stable periods. These up-down jumps allow the DCA strategy to serve its purpose of spreading out the risk of buying equities at the "wrong" time.

So when will a DCA approach underperform? This strategy will not help investor performance if, over the investor's DCA horizon, the markets move generally up. In this case, there is little or no opportunity to buy low. Since markets are experiencing gains in this scenario, every time more cash is invested, it is being invested at a higher cost, and an investor would be better served by investing the money up front. On the flip side, this strategy will work extremely well in a period where markets are consistently moving downward and then appreciate. In this case, every new purchase is made at a lower cost than the previous one.

(1) *A Random Walk Down Wall Street.* **Malkiel, B.G.** New York : Norton, 1975. p. 242.

Given that we know when DCA would work best, it's intuitive to think that a DCA strategy would, more often than not, not benefit investors. This is because we expect that, in general, markets move up; the S&P 500 Index yielded positive returns in over 60% of the months between January 1, 1926 and December 31, 2017, and in over 70% of the years between 1926 and 2017. However, intuition is not enough to validate the claim that lump-sum investing strategies (investing all available investable assets at once) perform 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, 2017. 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.

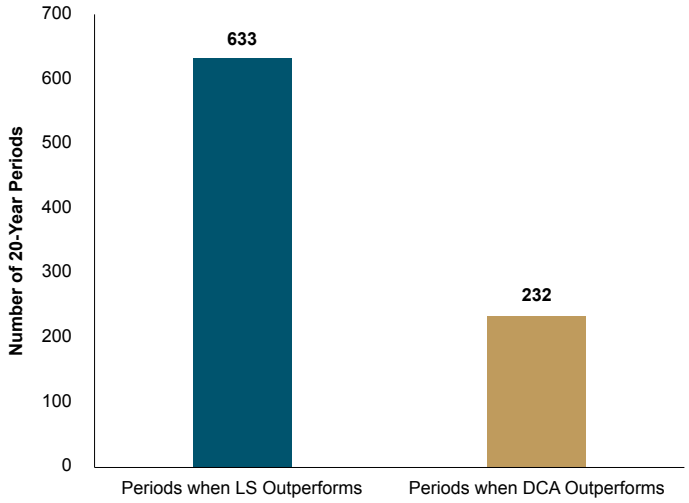
For the purposes of this study, we assumed zero transaction costs. This assumption favors the DCA strategy since, by design, the DCA strategy involves much more trading, which results in higher transaction costs. The objectives of this back-test were twofold:

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 1,093 such 12-month periods between January 1, 1926 and December 31, 2017.
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 strategies were fully invested in the S&P 500 Index for the next 19 years. There were a total of 865 such periods, with the first 20-year period starting in January 1, 1926, and the last 20-year period starting on January 1, 1998.

We analyzed every rolling 12-month period between January 1, 1926 and December 31, 2017 that had a corresponding 20-year period to determine whether the DCA or non-DCA strategy outperformed. The results of this part of the study are presented in Exhibit 1.

(2) *A Note on the Suboptimality of Dollar-Cost Averaging as an Investment Policy.* **Constantinides, George M.** 2, 1979, Journal of Financial and Quantitative Analysis, Vol. 14, pp. 443–450.
(3) *Lump-sum Investing Versus Dollar-Averaging.* **Rozeff, Michael S.** Buffalo : s.n., 1994, The Journal of Portfolio Management, pp. 45–50.
(4) *Does Loss Aversion Explain Dollar-cost Averaging?* **Leggio, Karyl B. and Lien, Donald.** 2001, Financial Services Review, Vol. 10, pp. 117–127.

Exhibit 1: Historical Success Rates: LS vs. DCA



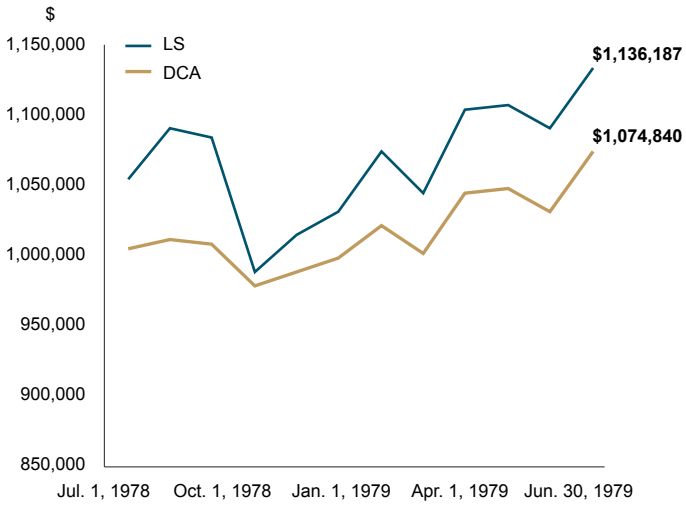
As can be seen in Exhibit 1, LS investing outperformed the DCA strategy in 633 out of the 865 periods (73% of the time). In other words, in nearly three out of four 20-year rolling periods, one would have been better off investing a lump sum as opposed to using a DCA strategy.

On average, at the end of a 20-year period, an investor who chose the LS strategy would have had $432,838 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 $63,513. The $432,838 average difference at the end of the 20 years corresponds to this average difference of $63,513 obtained at the end of the first year. Exhibit 3, for instance, shows a 12-month period (from July 1, 1978 through June 30, 1979) that had a 12-month outperformance of $61,347, which is a typical example of the difference in performance between the LS and the DCA strategy.

Exhibit 2: Average Ending Amounts for LS and DCA
Jan. 1, 1926–Dec. 31, 2017

Rolling 12-Month Periods (That had a Corresponding 20-Year Period)	
Average Ending DCA Amount	$1,070,911
Average Ending LS Amount	$1,134,424
Average Outperformance of LS Over DCA	$63,513
Rolling 20-Year Periods	
Average Ending DCA Amount	$9,147,647
Average Ending LS Amount	$9,580,485
Average Outperformance of LS Over DCA	$432,838

Exhibit 3: Growth of Wealth
Representative 12-Month Period



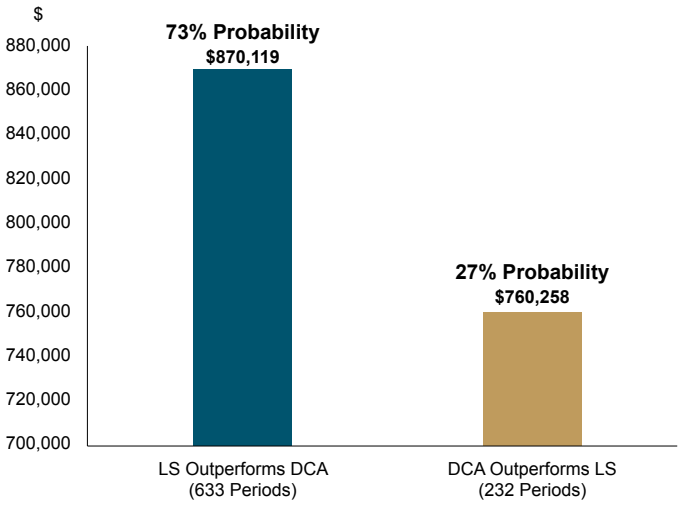
It is interesting to note that in the instances in which DCA outperformed LS (approximately 27% of the time), the magnitude of that outperformance was less than when LS outperformed DCA. Specifically, during the 633 20-year periods in which LS did better than DCA, the average cumulative outperformance was $870,119 on our initial $1 million investment. During the 232 periods in which DCA did better than LS, the average cumulative outperformance was $760,258 (See Exhibits 4 and 5).

Exhibit 4: Periods of LS and DCA Outperformance
Rolling 20-Year Periods (Jan. 1, 1926–Dec. 31, 2017)

Periods in Which LS Outperforms DCA	
Initial Investment Amount	$1,000,000
Number of Periods	633
Average Ending DCA Amount[1]	$8,798,809
Average Ending LS Amount[1]	$9,668,928
Average Outperformance of LS Over DCA[1]	$870,119

Periods in Which DCA Outperforms LS	
Initial Investment Amount	$1,000,000
Number of Periods	232
Average Ending DCA Amount[2]	$10,099,432
Average Ending LS Amount[2]	$9,339,174
Average Outperformance of DCA Over LS[2]	$760,258

Exhibit 5: Relative Outperformance[3]
Rolling 20-Year Periods (Jan. 1, 1926–Dec. 31, 2017)



While these findings make a compelling case for a lump-sum approach over the long term, how do the results compare over shorter periods of weak market performance? 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, in an average period, 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.

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.

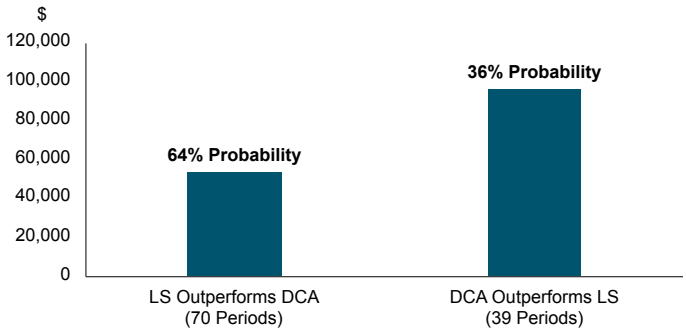
Exhibit 7: Periods of LS and DCA Outperformance
Rolling 12-Month Periods (Jan. 1, 2001–Dec. 31, 2010)

Periods in Which LS Outperforms DCA	
Number of Periods	70
Average Ending DCA Amount[1]	$1,070,046
Average Ending LS Amount[1]	$1,148,504
Average Outperformance of LS Over DCA[1]	$78,458

Periods in Which DCA Outperforms LS	
Number of Periods	39
Average Ending DCA Amount[2]	$931,765
Average Ending LS Amount[2]	$826,846
Average Outperformance of DCA Over LS[2]	$104,919

[1] In periods in which LS outperforms DCA.
[2] In periods in which DCA outperforms 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 8: Relative Outperformance by Strategy
Rolling 12-Month Periods (Jan. 1, 2001–Dec. 31, 2010)



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; 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 common misconception among many investors and even investment professionals that DCA is a superior investment strategy in terms of risk management and even 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, which is a result 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 better risk-adjusted returns.

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 suboptimal 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, and argues that, by using a DCA strategy, investors feel removed from part of the responsibility of potentially poor investment outcomes. The possible explanations for the use of DCA strategy seem to relate to the irrationality of investors.

In fact, 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.

Conclusion

DCA has been a popular investment strategy for 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 over most historic periods, it is important to understand the underlying reasons that cause investors to choose DCA and some investment professionals to recommend DCA. Risk-averse investors, who may be unwilling to invest into risky assets all at once, find the more gradual approach of DCA strategies emotionally comforting. Investment professionals such as financial advisors find DCA to be an easy way of encouraging investors to save. As long as both individuals and professionals have well-informed and clear expectations for a Dollar-Cost Averaging approach to investing their assets, it can serve a function in managing both market and behavioral risk, even if it is sub-optimal from a statistical perspective.

(4) *Does Loss Aversion Explain Dollar-cost Averaging?* **Leggio, Karyl B. and Lien, Donald.** 2001, Financial Services Review, Vol. 10, pp. 117–127.
(5) *The Time-Diversification Controversy.* **Thorley, Steven R.** 3, 1995, Financial Analysts Journal, Vol. 51, pp. 68–76.
(6) *A Behavioral Framework for Dollar-Cost Averaging.* **Statman, Meir.** 1, 1995, The Journal of Portfolio Management, Vol. 22, pp. 70–78.