

DOLLAR COST AVERAGING VS LUMP SUM: EVIDENCE FROM INVESTING SIMULATIONS ON REAL DATA

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ABSTRACT

Dollar Cost Averaging is a periodic investment of equal dollar amounts in stocks which allegedly can reduce (but not avoid) the risks of security investment. Even if some academic contributions questioned the alleged benefits, several professional investment advisors and websites keep on suggesting it. In this paper we use simulation to analyze Dollar Cost Averaging performance and compare its results to Lump Sum investment. We consider 30 international funds and 30 stocks to simulate investing over different period windows in order to assess whether this strategy is better than investing the whole available sum at time 0.

1 INTRODUCTION

Decision-making is a complex process which is often plagued by errors leading to poor decisions (Bazerman and Moore 2013). Although important contributions suggest approaches to make better decisions (see, for instance Hammond, Keeney, and Raiffa 1999), biases and heuristics are likely to affect the judgement of all types of professionals (Bazerman and Moore 2013). A heuristic can be defined as a “rule of thumb” that provides a best-guess solution to a problem (Goldstein 2005). In particular, when decisions are made under uncertainty, heuristics have been well documented (Tversky and Kahneman 1974). Since investment decisions are often based on beliefs concerning the likelihood of uncertain events, it is not surprising that different heuristics have been proposed. Among the different investment strategies, Dollar Cost Averaging (DCA) (Pye 1971) seems to be quite popular. Although several academic studies have pointed to the underperformance of DCA especially when compared with simple lump sum (LS) (see Greenhut 2006 for a review), financial advisors keep on suggesting this passive investment strategy. Greenhut reports to have found as many as 250 sites discussing DCA with more than half providing illustrations of the “cost benefit” of DCA. Since 2006 something has changed: a recent search of “Dollar Cost Averaging” on Google.com (Google.com) has provided about 1,070,000 results and among the first 30 results as many as 12 sites illustrate “the benefits of Dollar Cost Averaging”.

By contrast, in Italy DCA seems to remain quite popular. In fact, a recent search of “Piani di accumulo capitale” on Google.it (Google.it) has provided about 184,000 results and as many as 23 sites advocating this investing strategy among the first 30 results. It is surprising that among these we can find some of the major Italian banks.

In this paper we use simulation to compare the performance of DCA to LS, considering 30 investment funds and 30 Italian stocks. The paper is organized as follows. In Section 2 the DCA strategy is exposed. In Section 3 we describe the simulation we have considered to compare DCA

performance to LS, then in Section 3 the results of our analysis are summarized and discussed. Finally, the last section is devoted to conclusions and further research.

2 DOLLAR COST AVERAGING

Dollar Cost Averaging (DCA) is an investing strategy which, over a given time interval, calls for the periodic investment of a fixed amount of money in a stock or portfolio at each period. Quite often this strategy is recommended over investing the whole amount in a lump sum (LS) at time zero (Brennan, Li, and Torous 2005). Brokerage firms, mutual funds and professional financial advisors have been suggesting this strategy for a long time in spite of several academic studies which have pointed to underperformance of DCA when compared to LS. As mentioned in the Introduction, it is possible to find several websites claiming “The Benefits of Dollar Cost Averaging” and stating that, with this strategy, “you buy more shares of an investment when prices are low and less when they are high”. Also, some sites claim that in such way the investor avoids “the difficult or even impossible task of trying to figure out the exact best time to invest”. Furthermore, some sites even provide examples similar to the one illustrated in Table 1. In this hypothetical example, assuming that fractional shares may be purchased, the investor used a dollar cost averaging approach, making regular investments of \$100 each month. When the share prices were higher, the investor bought fewer shares. And, when the share prices were lower, the investor bought more shares.

Table 1: A typical example illustrating the alleged benefits of DCA.

Date	Shares Price	Investment Amount	Shares Purchased
January	\$ 25	\$ 100	4
February	\$ 25	\$ 100	4
March	\$ 22	\$ 100	4.55
April	\$ 20	\$ 100	5
May	\$ 18	\$ 100	5.56
June	\$ 17	\$ 100	5.88
July	\$ 15	\$ 100	6.67
August	\$ 15	\$ 100	6.67
September	\$ 16	\$ 100	6.25
October	\$ 20	\$ 100	5
November	\$ 25	\$ 100	4
December	\$ 28	\$ 100	3.57
Total		\$ 1,200	61.15
Average Cost Per Share	\$ 19.62		

Usually, this result is compared to what the result would have been investing \$1200 in a lump sum, namely buying 48 shares at an average cost per share of \$25. It is immediate to show that with DCA the investors end up with more shares than with LS, even over periods of time in which stock market is low. Usually, the websites end with providing the usual caveats and disclaimers about investment risks.

As mentioned in the Introduction several major Italian banks are quite enthusiastic in suggesting that DCA increases portfolio value and in claiming that this approach helps reducing market volatility.

3 COMPARING DCA TO LS THROUGH SIMULATION

Given the popularity of DCA with Italian websites we used simulation to compare DCA to LS considering thirty U.S. mutual funds that can be subscribed to in Italy. The sample of funds we considered mainly consisted of euro traded retail funds, which are managed by some of the major

banks and asset managers such as JP Morgan, Goldman Sach, Blackrock and Templeton. The mixed sample we considered consisted of funds that invest in the stock market, bonds, cash and mixed (stocks and bonds). For the sake of comparison, we also considered a sample of 30 stocks of major Italian companies, even if we were well aware of “of the inefficiency of a single security portfolio” (Brennan, Li, and Torous 2005, p.532). The funds and stocks we considered are reported in Table 2.

Table 2: The set of funds and stocks considered in the analysis

Funds	Stocks
BGF Euro Markets E2 EUR	A2A
Templeton EuroLand N Cap. EUR	Autogrill
BGF Asian Dragon E2 EUR	Astaldi
BGF Pacific Eq. E2 EUR	Beghelli
BGF Emerging Europe E2 EUR	Banca Intermobiliare
JPM Europe Equity D Acc EUR	Monte dei Paschi di Siena
Templeton European N Cap. EUR	Banco Popolare Società Cooperativa
Templeton Eastern Europe N Cap. EUR	Brembo
Franklin Templeton Japan N Cap. EUR	Cattolica Assicurazioni
BGF Japan Small & MidCap Opportunities E2 EUR	Centrale del Latte di Torino
BGF Global Opportunities E2 EUR	Banca Carige
BGF Emerging Markets E2 EUR	Datalogic
Templeton Growth (Euro) N Cap. EUR	De'Longhi
BGF New Energy E2 EUR	ENEL
BGF World Gold E2 EUR	ENI
BGF US Basic Value E2 EUR	EXOR
BGF US Small & MidCap Opportunities E2 EUR	FIAT Group
Templeton Global Balanced N Cap. EUR	Gabetti
BGF Global Allocation E2 EUR	Indesit
BGF Flexible Multi Asset E2 EUR	Interpump Group
BGF Euro Bond E2 EUR	Italcementi
Fidelity Euro Bond A Dis EUR	Luxottica
BGF Euro Short Duration Bond E2 EUR	Mondadori
AXA WF Euro Bonds A Cap. EUR	Mediaset
BGF Global High Yield Bond Eur Hedged E2 EUR	Pininfarina
Templeton Euro High Yield N Cap. EUR	Saipem
Fidelity European High Yield A Dis EUR	Tenaris
BNY Mellon Global Bond A EUR	Tiscali
GS US Fixed Income E Cap EUR	Telecom
Fidelity Us High Yield A Dis EUR	Zucchi

We considered quotations from January 2003 through December 2012, i.e., ten years. In such way, we could investigate whether the—still popular—suggestion to use DCA strategy was supported by recent actual performances. Both samples were selected among those traded in Italy. In particular, stocks were selected among the largest Italian companies. Moreover, in order to increase comparability, funds were selected among those investing in stocks. For each fund we thus considered the different length investment windows from 1 month width, ie., buying at the beginning of the first month and evaluating the portfolio value at beginning of the next month, up to 120 months, with DCA, the investment is spread over 119 periods and at period 120 the portfolio is evaluated. For all the possible

investment windows the beginning dates were considered within the 10 interval we analyzed. For each investment, we thus consider 119 1-period investment windows, 118 2-period investment windows up to 1 119-period investment window, for a total amount of 7140 comparisons. Furthermore, we assumed that the money was kept on a saving account with zero interest rate, which is consistent to the Italian bank situation for private small investors (for some of the consequences of zero lower bound on nominal interest rate, see Ullersma 2002). Finally, we observe that our comparison made sense when the investor had sufficient money to invest at the beginning, otherwise several options are available to find money in one's budget for investing, see, e.g., (Bajtelsmit 2006, p.350).

For each security we plotted the mean obtained by DCA and LS and also the mean plus/minus one standard deviation, as illustrated in Figures 1, 2 and 3. For some funds the average portfolio value with LS outperforms DCA (Figure 1), on the contrary, for some others the opposite is true (Figure 2); finally, in other cases the result depends on the width of the window. Actually, these results are consistent with the fact that DCA is suboptimal when the market is in an uptrend (Greenhut 2006).

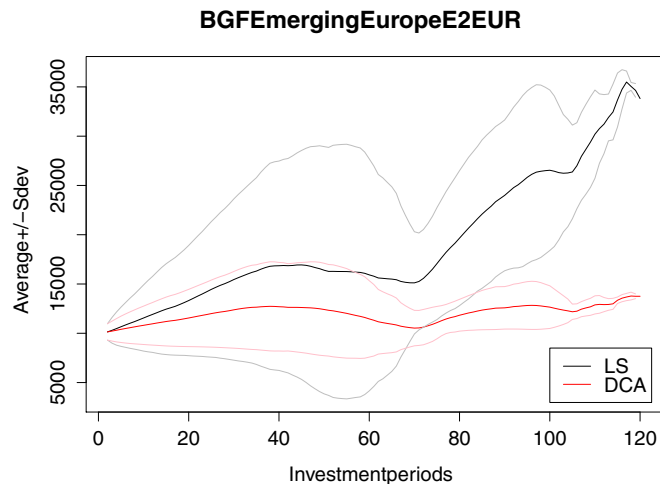


Figure 1: Portfolio value with DCA and LS at the end of investment period when investing in BGF Emerging Europe E2 EUR.

To obtain a wider perspective about the two samples of funds we have considered, some descriptive statistics are reported in Table 3.

Table 3: Portfolio value descriptive statistics with DCA and LS

	strategy	average	standard deviation
Funds	DCA	10510.16	1797.386
	LS	11388.31	3916.935
Stocks	DCA	9747.364	5012.186
	LS	10702.641	9994.872

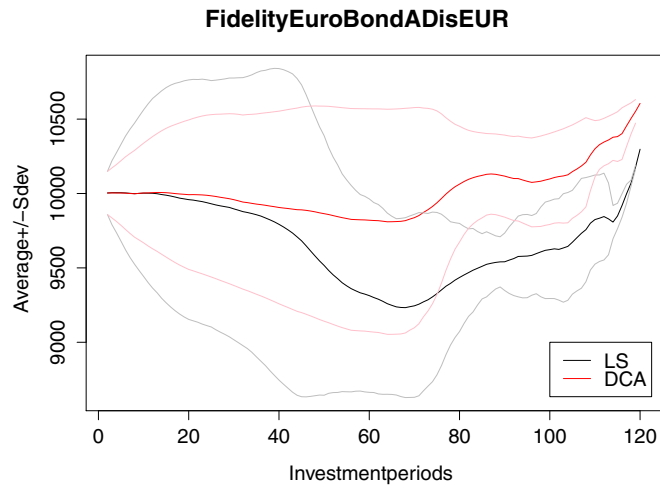


Figure 2: Portfolio value with DCA and LS at the end of investment period when investing in Fidelity Euro Bond A Dis EUR.

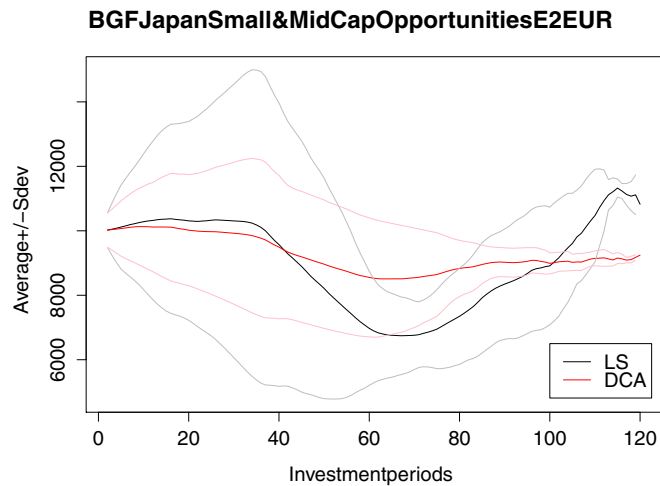


Figure 3: Portfolio value with DCA and LS at the end of investment period when investing in BGF Japan Small & MidCap Opportunities E2 EUR.

We can see that with both strategies the average portfolio value is larger than the invested capital, nevertheless with LS the standard deviation is larger than with DCA. This larger variability may suggest that, in principle, DCA could be superior to LS for more risk averse investors, yet the actual reason might be that such investors should not be investing the whole of their wealth in the market portfolio, as correctly pointed out by Brennan, Li, and Torous (2005).

As the distribution of the end period value is not normal and the difference between DCA and LS is not symmetrical around the median, we cannot use either the Student's t-test nor the Wilcoxon rank-sum test, therefore we use graphical analysis as suggested by Loftus (1993). Therefore, we plot the final portfolio values considering DCA and LS strategies for each of the 7140 windows in Figure 4.

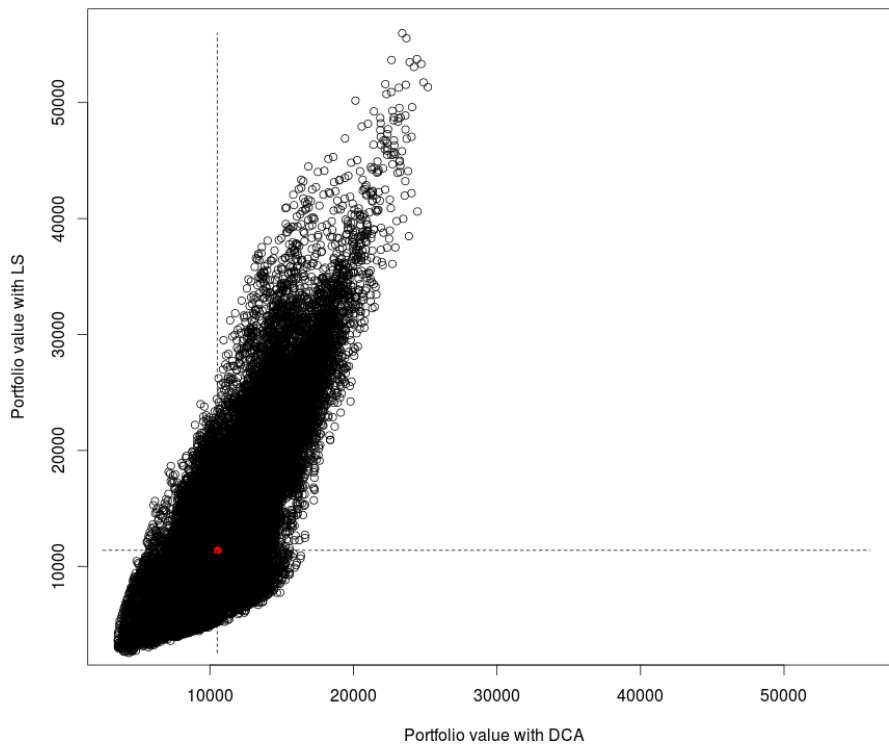


Figure 4: Funds: portfolio value with DCA and LS at the end of investment period.

The point corresponding to the average portfolio values with DCA and LS is depicted in red and the dashed lines determine four regions. In the top right region we find investments for which both DCA and LS provided a final value larger than the respective averages; in the top left region we find investments for which LS provided a final value larger than the average and DCA a final value lower than the average; similar considerations hold for the other regions. It can be observed that most of the points lie above the 45 degrees line. As for the stocks this phenomenon is less evident, as illustrated in Figure 5.

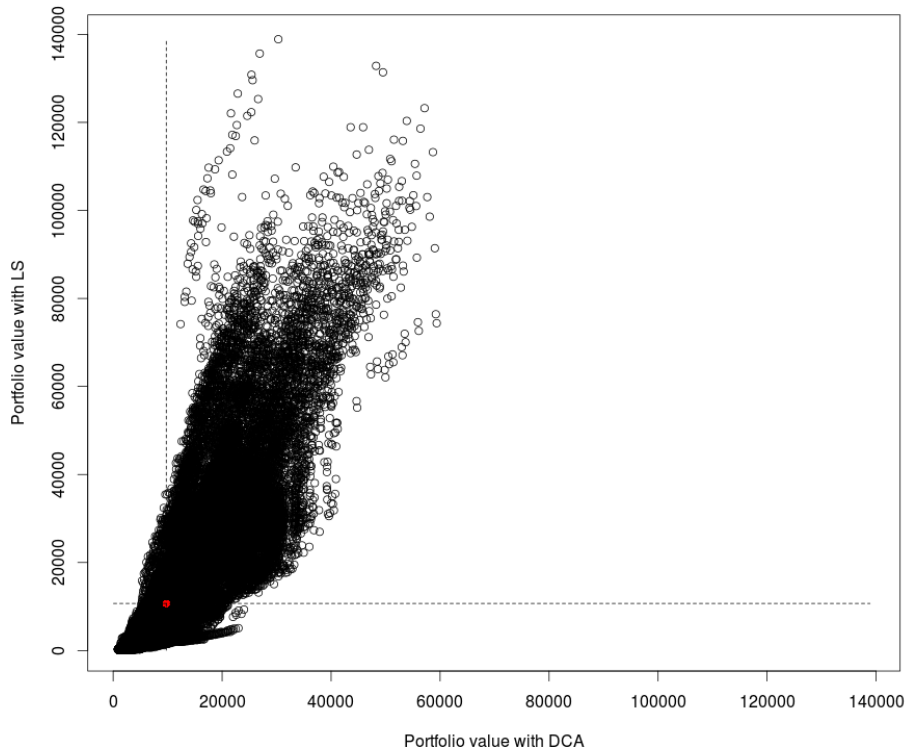


Figure 5: Stocks: portfolio value with DCA and LS at the end of investment period.

For each of these securities we also computed the percentage of time in which DCA outperforms LS. These results are presented in Tables 4 and 5. From these figures, we see that DCA outperformed LS only 35.97% of the times for funds and 53.38%, as stocks are concerned. This can be confirmed by the fact the market for stocks was less uptrend than the funds market in the period we considered.

Table 4: Portfolio value comparison for funds

Fund	% DCA > LS
AXA WF Euro Bonds A Cap. EUR	9.89
BGF Asian Dragon E2 EUR	24.52
BGF Emerging Europe E2 EUR	29.26
BGF Emerging Markets E2 EUR	22.58
BGF Euro Bond E2 EUR	29.02
BGF Euro Markets E2 EUR	29.02
BGF Euro Short Duration Bond E2 EUR	7.34
BGF Flexible Multi Asset E2 EUR	32.87
BGF Global Allocation E2 EUR	24.79
BGF Global High Yield Bond Eur Hedged E2 EUR	24.68
BGF Global Opportunities E2 EUR	32.94
BGF Japan Small & MidCap Opportunities E2 EUR	55.80
BGF New Energy E2 EUR	36.43
BGF Pacific Eq. E2 EUR	34.30
BGF US Basic Value E2 EUR	43.96
BGF US Small & MidCap Opportunities E2 EUR	35.53
BGF World Gold E2 EUR	17.80
BNY Mellon Global Bond A EUR	17.49
Fidelity Euro Bond A Dis EUR	71.64
Fidelity European High Yield A Dis EUR	59.02
Fidelity Us High Yield A Dis EUR	72.86
Franklin Templeton Japan N Cap. EUR	53.03
GS US Fixed Income E Cap EUR	66.30
JPM Europe Equity D Acc EUR	34.41
Templeton Eastern Europe N Cap. EUR	33.42
Templeton Euro High Yield N Cap. EUR	29.87
Templeton EuroLand N Cap. EUR	37.41
Templeton European N Cap. EUR	36.40
Templeton Global Balanced N Cap. EUR	34.71
Templeton Growth (Euro) N Cap. EUR	41.83
Average	35.97

Table 5: Portfolio value comparison for stocks

Stock	% DCA > LS
A2A	44.96
Autogrill	33.42
Astaldi	55.24
Beghelli	61.85
Banca Intermobiliare	54.83
Monte dei Paschi di Siena	65.49
Banco Popolare Società Cooperativa	36.50
Brembo	30.60
Cattolica Assicurazioni	57.76
Centrale del Latte di Torino	61.09
Banca Carige	39.24
Datalogic	57.44
De'Longhi	58.28
ENEL	43.43
ENI	18.00
EXOR	34.47
FIAT Group	69.79
Gabetti	75.64
Indesit	36.68
Interpump Group	52.25
Italcementi	31.83
Luxottica	74.15
Mondadori	75.67
Mediaset	64.31
Pininfarina	72.76
Saipem	17.13
Tenaris	76.67
Tiscali	30.04
Telecom	90.43
Zucchi	81.54
Average	53.38

Finally, by comparing the distribution graph of portfolio values with different strategies it is clear that LS provides a higher expected value and, at the same time, it displays a larger dispersion than DCA. This is evident for both funds and stocks, as illustrated in Figures 6 and 7. Graphical analysis confirms the descriptive statistics reported in Table 3.

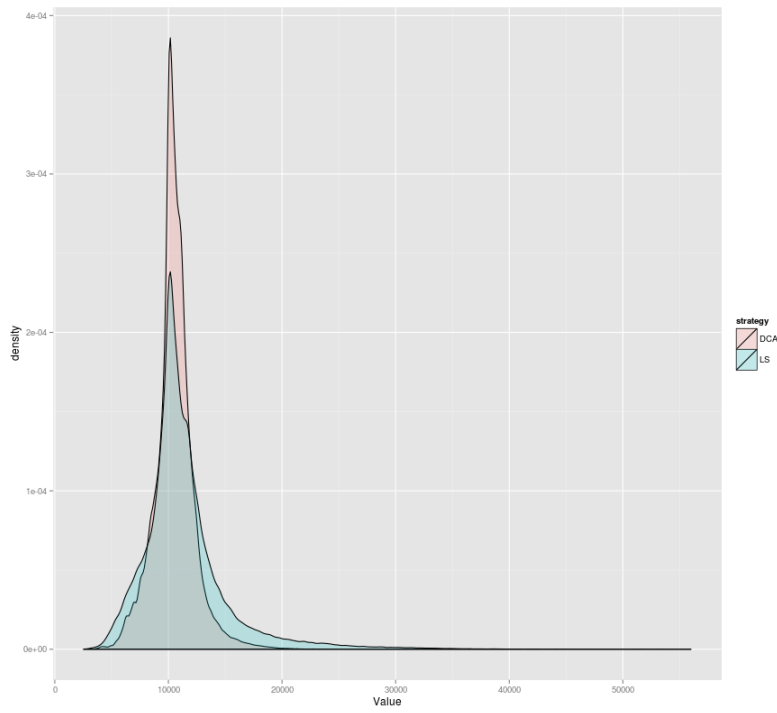


Figure 6: Funds: distribution of portfolio value with DCA and LS at the end of investment period.

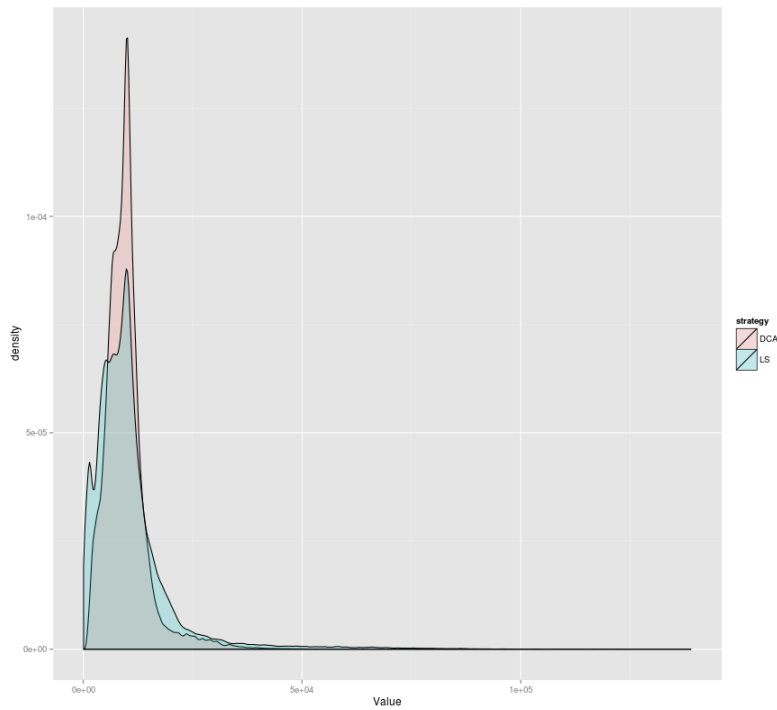


Figure 7: Stocks: distribution of portfolio value with DCA and LS at the end of investment period.

Even if we were considering the Italian Stock market only, our results are in line with (Brennan, Li, and Torous 2005), therefore there is no particular reason for the popularity of this strategy among Italian financial advisors.

4 CONCLUSION

Analysis of the simulations shows that the claim that DCA yields a higher portfolio value—as suggested by several websites—seems not to hold.

On the contrary, LS yields a higher portfolio value, especially when funds are considered. Since usually DCA is suggested to investors when subscribing to investment funds, our results highlight that this may not be a good strategy. This aspect has been already proved using optimal control techniques by Merlone (1993) and, from the viewpoint of a rational investor with a von Neumann-Morgenstern utility function, by Brennan, Li, and Torous (2005). As for stocks, in the timeframe we considered, DCA strategy seems to provide higher final value, even if it seems unadvisable to apply this strategy to a single stock when taking into the underdiversification effect of buying a single stock, see for example (Brennan, Li, and Torous 2005). Another important aspect are transaction costs. In our study, we have not considered transaction costs—which in the case of DCA may offset profits (Bajtelsmit 2006). Obviously, had other stocks and funds been chosen, the results may have been different, yet, as it is well known “By its nature all stock is risky... In addition, the actual return on your investment will vary over time and with economic conditions” (Bajtelsmit 2006, p. 401). Nevertheless, our conclusions are in line with some of the suggestions (Bazerman and Moore 2013) given in order to avoid common investment mistakes. That is, taking the time to formulate an asset allocation and avoiding to pay high fees, commissions and transaction costs. In this sense, while diversification presents its advantages in terms of risk reduction, asset allocation diversification seems to be a less controversial suggestion than temporal diversification. Finally, Bazerman and Moore (2013) warn against external sources encouraging investors’ natural optimism. In fact, often, these sources “remind us of the wise advice they provided in the past, but generally neglect to mention advice that were flat-out wrong” (Bazerman and Moore 2013, p.166). Therefore, we would not suggest to invest money just looking at a well crafted example and forgetting transaction costs that are not mentioned. This, of course, applies to all the cases in which the same commission has to be paid for each purchase. Given the results of our analysis, the diffusion of such a scheme in the Italian websites seems to be the result of ill-conceived financial advice.

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