Dollar cost averaging: the numbers game

Investment profits come from quality, not quantity

Many industry practitioners have extolled the virtues of dollar cost averaging as a method of gaining from reductions in asset prices when the market declines. Supporters of DCA hold that a fall in the market presents a buying opportunity in that the number of assets bought will be higher than before the fall. MICHAEL DALVEAN contends that this view reflects confusion between the number of assets bought and the amount of capital invested.

A

n Australian fund manager has defined dollar cost averaging (DCA) thus: “Dollar cost averaging is founded on the principles of discipline and patience. Investors apply these principles when participating in a regular investment plan. . . Every time they invest they are buying ‘units’, each with a dollar value which goes up and down over time. The same amount of money invested will buy more units in a particular fund when the price falls and fewer when it rises. The dollar cost per unit to the investor will average out over time. As a result, the units acquired could end up being worth more then the price paid” (The Story of Regular Investing and Dollar Cost Averaging, Rothschild Australia Asset Management Ltd).

The following example is based on an example provided by the fund manager:

An investor wishes to invest $700. Instead of investing the entire

<table>
<thead>
<tr>
<th>Month</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>$100</td>
<td>$100</td>
<td>$100</td>
<td>$100</td>
<td>$100</td>
<td>$100</td>
<td>$100</td>
</tr>
<tr>
<td>Unit cost</td>
<td>$100</td>
<td>$50</td>
<td>$25</td>
<td>$10</td>
<td>$25</td>
<td>$50</td>
<td>$100</td>
</tr>
<tr>
<td>Units purchased</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>10</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

At the end of the 7 months the situation is:

<table>
<thead>
<tr>
<th>Amount invested</th>
<th>$700</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units purchased</td>
<td>24</td>
</tr>
<tr>
<td>Unit value at period end</td>
<td>$100</td>
</tr>
<tr>
<td>Total value</td>
<td>$2400</td>
</tr>
<tr>
<td>Profit</td>
<td>$1700</td>
</tr>
</tbody>
</table>
amount up front, he invests $100 each month. Over the seven months the cost per unit changes.

The results are shown in Table 1.

The fund manager claims: "A profit was achieved without the price per unit ever going above the starting price of $100. While there is no guarantee against a loss, dollar cost averaging has proven its value over many years, in good times and bad."

It would seem, however, that the assumption that dollar cost averaging is beneficial is based on a confusion between the sum invested and the number of units purchased. For the purposes of investment, the number of units purchased is not relevant. What is important is the accretion or otherwise of the capital invested.

The best way to appreciate this is to imagine a situation in which the price falls from $100 in period 1 to $1 in period 2 and then subsequently increases by $1 each period. The number of units purchased in period 2 is 100 times greater than the number of units purchased in period 1; the number of units purchased in period 3 is 50 times the number of units purchased in period 1 and so on. Clearly, the number of units purchased is much higher than if the units price had risen rather than fallen after period 1 but this is of no value to the investor as the fall in the price of units in period 2 has wiped out 99% of the capital invested in that period.

The above situation shows that it is erroneous to consider a fall in the price in the intervening period as beneficial for the current period’s purchase without having regard to the whole portfolio. Certainly it is good to buy when the price is low but if a portion of the total capital has already been invested in the preceding periods, a fall in the price of the unit will drag down the value of the previous periods’ investments.

Advocates of DCA often say that the fall in the price of units enables the investor to buy more units. However, there is no obvious advantage in this.

There is no advantage in holding 20 units at $0.50 compared with 10 units at $1.

Further, the example given shows a net gain from DCA but this is an unusual scenario seldom replicated in real-world markets and certainly not for any long period. In fact, it is very difficult to find a long-run situation in which a DCA strategy is more effective in generating high returns than a buy-and-hold strategy. The examples given by proponents of the DCA strategy use highly artificial examples which, although not impossible in practice, are not drawn from actual periods in the market.

THE EVIDENCE

To put the above comments into perspective, a DCA strategy has been constructed using monthly Australian sharemarket data over the period 1980-97. This portfolio was compared with a buy-and-hold (B&H) strategy. Over the long term, the B&H strategy outperformed the DCA strategy. This was so even when the opportunity cost of having capital invested outside the sharemarket, which is entailed in the DCA strategy, was taken into account.

METHODOLOGY

A dollar cost averaging strategy was applied to the All-Ordinaries price index from July 1980 to October 1997. The price index was used in order to isolate the effects of price changes. It was assumed that $1 was invested each month over this period. The study did not take into account transaction costs.

Thus, the total amount invested over the 208 periods was $208.

The value of the DCA portfolio for each period was calculated as:

\[ V_t = (V_{t-1} \times (AOI_t/AOI_{t-1})) + 1 \]

where \( V_t \) is the value of the portfolio in any given period, \( AOI_t \) is the All-Ordinaries price index in the period, \( V_{t-1} \) is the value of the portfolio in the period immediately preceding, and \( AOI_{t-1} \) is the All-Ordinaries price index in the period immediately preceding.

The value of the portfolio changes in any one period as a result of the periodic investment of $1 and the change in the All-Ordinaries index. The accumulated value of the portfolio is the value of the periodic investments multiplied by the accumulated value of all changes in the index. Thus, the value of the first dollar invested changes according to the accumulated changes in the AOI. The value of the second dollar invested changes according to the accumulated changes in the AOI from the second period onwards, and so on. The last dollar invested does not change until the following period.

The DCA portfolio was compared with a B&H portfolio of $208 invested at the start of the period and held for the entire period. The value of the B&H portfolio was calculated as:

\[ B_t = B_{t-1} \times (AOI_t/AOI_{t-1}) \]
where $B_t$ is the value of the portfolio in any given period, $A_Ot$ is the All-Ordinaries price index in the period, $B_t-1$ is the value of the portfolio in the period immediately preceding, and $A_Ot-1$ is the index in the period immediately preceding.

The results are plotted in Figure 1.

It is clear from the graph that the effect of DCA is to smooth out fluctuations in the AOI. During periods in which the AOI is falling, the B&H portfolio suffers to a great extent, as the full amount of the $208 plus growth is subject to the fall. In the case of the DCA portfolio, because less is invested at any given time, a fall in the market has a smaller absolute effect on the portfolio. However, the corollary of this is that the reverse is true during times of growth in the sharemarket. As the long-run movement of the market is upward and the DCA portfolio has at any given time less invested in the sharemarket, it follows that on average the DCA portfolio will underperform the B&H strategy. And even when the full $208 is invested in the DCA portfolio, there is no way that it can catch up to the B&H portfolio.

It could be argued that the DCA and B&H strategies are not directly comparable in the above way because no account is taken of the advantage of having the full $208 invested in the sharemarket in the case of the B&H strategy, while the DCA portfolio is only partially invested in the sharemarket at any time until the end of the period. In other words, the opportunity cost of not having money in the sharemarket in the case of the DCA portfolio is not accounted for.

Therefore, an adjustment needs to be made to the DCA portfolio to account for the opportunity cost of having capital outside the sharemarket. This has been done by assuming that both the DCA and the B&H portfolios begin with $208. The DCA investor invests $1 per period and invests the balance of the $208 at the 90-day bank bill rate.

Thus, the following was added to the value of the DCA portfolio:

$$(R_t-1 + (208 - T) \times (rt/12))$$

where $R_t-1$ is the accumulated value of interest payments on the portion of the portfolio invested in bank bills up to $t-1$, $T$ is the number of periods since the start of the portfolio and $r_t$ is the annual 90-day bank bill rate in period $t$.

$V_t = (V_t-1 \times (AOlt/AOlt-1)) + 1 + (R_t-1 + (208 - T) \times (rt/12))$

The effect of this is to simulate a situation in which the DCA portfolio is drawing down $1 a month from a lump sum of $208 invested at the bank bill rate and investing the $1 in the All-Ordinaries. The results are shown in Figure 2.

While not as pronounced as the situation represented in the first graph, the result vindicates the general conclusion that the return on the buy-and-hold strategy is superior.

It follows that, as a long-term strategy, DCA is less effective than a B&H strategy if high returns are sought. The reason for this is that DCA is only advantageous in a falling market. Over the long term, it is expected that the market will rise. Therefore, over the long term it is better to engage in a buy-and-hold strategy.

DCA has always been seen as a method for conservative investors to maximise their wealth over the long term. It is clear from the data, however, that DCA is a short-term strategy useful only in times of falling markets.

The idea that DCA is an unambiguously advantageous investment strategy is not supported by the current study. This does not mean that periodic investment is not a good idea. It is better to have money in the sharemarket than not in the sharemarket due to the higher returns available in that asset class in the long run. However, the above shows that DCA as a strategy on its own results in lower returns than a buy-and-hold strategy.

Critics of the above approach could argue that the portion of the portfolio invested in bank bill should actually be invested in 10-year bonds, as the time period of the study is clearly long-term. In this regard, the following two points should be noted:

- In the period concerned, the average monthly rate on 10-year bonds was 11.61%. The average rate on 90-day bank bills was 11.55%. Thus, there would not have been a great difference in results.
- The All-Ordinaries price index was chosen for this study so the effects of price changes could be isolated. If the 10-year bond rate was used to calculate the opportunity cost of the portion of the DCA portfolio not in the sharemarket, the appropriate share index to have used in the study would have been the accumulation index. This would have increased the extent to which the B&H strategy outperformed the DCA strategy.

Continued on page 40
Dollar cost averaging: the numbers game

The foregoing analysis concentrates on returns. For a more comprehensive comparison it is worthwhile to consider some kind of risk/return tradeoff.

In the current situation the Sharpe ratio has been selected. This expresses the excess return of the portfolio over the risk-free rate (in this case, the 90-day bank bill rate) in terms of the volatility of the portfolio measured by the standard deviation.

It should be pointed out that interest rates were very high in the 1980s; the pure Sharpe ratio is therefore not entirely useful because at times the risk-free rate was higher than the return on equities. For this reason, a raw Sharpe measure – the return on the portfolio divided by the standard deviation – has been included in Table 2 so that a more comprehensive comparison can be made.

The time-weighted, rather than money-weighted, return has been used to determine the monthly returns on the DCA portfolios. The reason is that, in the examples given, there are no interim deposits requiring discounting in fractional periods.

Thus, the monthly return on the DCA portfolios has been calculated the following way:

\[
\frac{(\text{Value in Period } t/\text{Period } t ) - (\text{Value in period } t-1/\text{Period } t-1)}{\text{Value in period } t-1/\text{Period } t-1}
\]

The effect of this is to express the value of the portfolio each month in terms of the value of one share or unit in the portfolio. In the third period, for example, three contributions to the portfolio have been made. Thus, the return on the portfolio is the value of the portfolio in the third period divided by three, all over the value of the portfolio in the second period divided by two.

The average monthly return on the B&H portfolio is 0.08%. This is higher than the Pure DCA portfolio, which had an average monthly return of 0.55% but not as high as the DCA + Cash portfolio of 1.12%.

The DCA + Cash portfolio had abnormally high returns in the first few periods due to the large injection of funds from the cash portion of the portfolio. This fell rapidly as the amount invested in cash fell. As an indication of the importance of these first few periods, the return on the DCA + Cash portfolio falls to 0.08 if the first four periods are excluded while the average monthly return on the pure DCA portfolio falls to 0.53% and the figure for the B&H portfolio is 0.78%.

As could be expected, the volatility on the DCA portfolio is lower than that on the B&H portfolio, as is the return. Thus, the risk-return trade-off is as expected.

However, the Sharpe ratio suggests that the B&H portfolio is superior to the Pure DCA portfolio. Both the raw Sharpe and the Sharpe ratios are higher with the B&H portfolio, indicating that the B&H portfolio represents a better level of return for each unit of volatility compared with the Pure DCA portfolio.

A slightly different picture emerges with the DCA + Cash portfolio. Both the return and the volatility on this portfolio are higher than that on the B&H portfolio. A possible explanation is that interest rates and returns on equities were high in the 1980s. Therefore, both the cash component and the equity component earned high returns and had a positive covariance. But returns to both fell dramatically after October 1987.

**CONCLUSION**

It is clear that DCA is not unambiguously superior to a B&H strategy. The intention of this study is to demonstrate that volatility does not, of itself, boost returns. The main target has been the fallacy that a fall in the market can be beneficial because buying 20 units at 50c is better than buying 10 units at $1.