A Behavioral Framework for Dollar-Cost Averaging

Dollar-cost averaging may not be rational behavior, but it is perfectly normal behavior.

Meir Statman

Investors with cash that is destined for stocks often use a dollar-cost averaging plan. They divide the cash into segments, and convert one segment at a time from cash to stocks according to a predetermined schedule. The alternative to dollar-cost averaging is lump-sum investment.

The popularity of dollar-cost averaging can be traced back at least to the 1940s. (See, for example, discussions in Ketchum [1947], Solomon [1948], and Weston [1949].) And that popularity has never waned.

For example, Clements [1994] writes in a *Wall Street Journal* column "aimed at ordinary investors who want to get their finances going in the right direction":

> Tumbling stock and bond prices can seem a lot less painful if you plan to buy more. One of the best ways of doing that is dollar-cost-averaging, which involves shoveling, say, $100 into the market every month, no matter what is happening to stock and bond prices (p. C1).

While popular, the practice of dollar-cost averaging is inconsistent with standard finance. This has been demonstrated by Constantinides [1979], who shows, within a theoretical framework, that dollar-cost averaging plans are suboptimal. It has also been demonstrated by Rozeff [1994], who shows using simulation that dollar-cost averaging is suboptimal.

An analysis of dollar-cost averaging is important for at least two reasons, one related to an understanding

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of the behavior of investors, and the other related to the effects of investor trading on security prices. Standard finance is a positive theory, a theory that makes predictions about the financial behavior of individuals and about the outcomes of the interactions between individuals in financial markets. The practice of dollar-cost averaging is prominent, and the inconsistency between the practice of dollar-cost averaging and the predictions of standard finance is too glaring to be ignored. Moreover, an understanding of the persistence of dollar-cost averaging provides insights into broader questions, such as the overall construction of portfolios.

This article offers a behavioral framework that is consistent with the persistence of dollar-cost averaging. I describe the roles of four behavioral elements in the attraction of such plans: prospect theory, aversion to regret, cognitive errors, and self-control (behavioral life cycle theory).

This work is part of a stream of work that describes the behavior of investors and the outcomes of their interaction in financial markets. Earlier work describes preferences for dividends (Shefrin and Statman [1984]), the reluctance to realize losses [1985], the susceptibility to cognitive errors and the preference for stocks of "quality" companies [1986, 1995b], the design of securities [1993], the pricing of securities [1994], and the construction of portfolios [1995a].

"Behavioral investors" make choices in a systematic, if suboptimal, fashion. This is not to advocate the selection of suboptimal portfolios. But a positive theory must be consistent with the behavior of many, if not most, individuals.

Some standard finance investors (and academics) think that behavioral investors can be easily educated to overcome their limitations. But even if they are right in their prescription, standard investors will be ineffective as teachers if they misperceive their students. Behavioral investors are numerous, and they are difficult to educate. The difficulty in the task of education is illustrated in Weston's [1949] and Sharpe's [1981] efforts.

Dollar-cost averaging calls for investing the same dollar amount, rather than the same number of shares, each period. Thus, a dollar-cost averaging investor buys more shares when the price is low than when the price is high. As Weston [1949] writes:

> In the usual exposition of the principle of dollar-cost-averaging, its merit is urged on the basis of a relationship that holds without exception: at any point after a fluctuation in security prices the average cost of total shares held is less than the average price of the shares (pp. 251-252).

Weston exposes the irrelevance of this fact: "The crucial test is whether the shares held can at any time be sold at a gain. For this to be possible, average cost must be less than the current market price per share" (p. 252).

Similarly, Sharpe [1981] notes that while it is mathematically interesting that the average price per share paid by a dollar-cost averaging investor is lower than the average price per share, it has no economic significance. Sharpe shows that while high volatility in stock prices corresponds to large differences between the average price per share paid by a dollar-cost averaging investor and the average price per share, dollar-cost averaging does not change uncertainty from vice to virtue. The passage of time since Weston's 1949 article and Sharpe's 1981 book seems to have done little to dampen enthusiasm for dollar-cost averaging

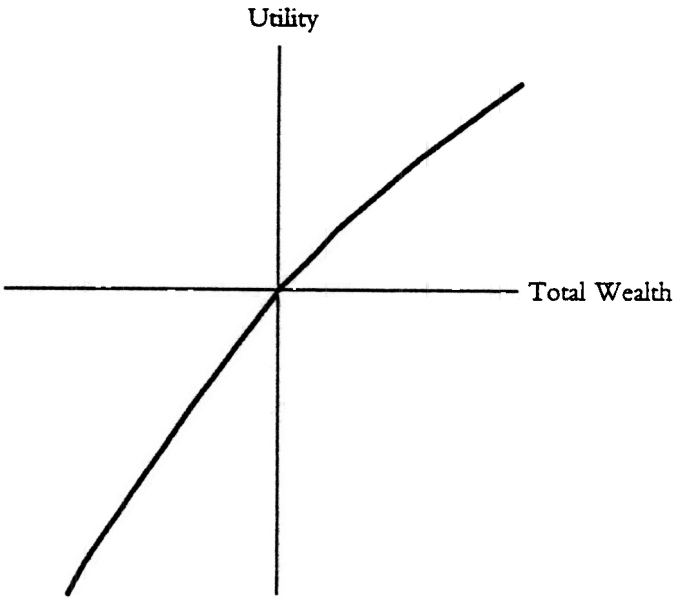
The world of standard finance is the world of frame invariance. Investors care about cash flows, but are indifferent among frames of cash flows. The pricing of options is a good example. The price of a call option on a stock is determined by the fact that the cash flows of the option can be replicated by the cash flows of a particular dynamic combination of a bond and the underlying stock. The fact that in the first case cash flows are described in terms of options, while in the second cash flows are described in terms of bonds and stocks is irrelevant to investors in a world of frame invariance.

Although the literature of standard finance has no relevant role for framing, the behavioral literature is replete with studies on the effects of frames on choice. The effect of frames is central in prospect theory, a positive theory of choice by Kahneman and Tversky [1979], and with it I begin the construction of the behavioral framework within which dollar-cost averaging takes place.

PROSPECT THEORY

Choices of standard finance investors conform to expected utility theory. Choices of "behavioral investors" conform better to prospect theory. Prospect theory investors evaluate their choices in terms of the potential gains and losses relative to reference points, while standard investors evaluate their choices in terms

EXHIBIT 1A
STANDARD UTILITY FUNCTION



of net cash flows (total wealth). Moreover, while standard investors are always risk-averse, prospect theory investors have an S-shaped value function over gains and losses that displays concavity (risk aversion) in the domain of gains and convexity (risk-seeking) in the domain of losses. (See Exhibits 1A and 1B.)

The origins of prospect theory are in Markowitz [1952], but its development is the work of Kahneman and Tversky [1979]. To understand the features of prospect theory, consider an experiment by Kahneman and Tversky. One group of subjects receives problem 1:

> 1. In addition to whatever you own, you have been given $1,000. You are now asked to choose between:
> A_1: A sure gain of $500, and
> B_1: A 50% chance to gain $1,000 and a 50% chance to gain nothing.

Another group of subjects receives problem 2:

> 2. In addition to whatever you own, you have been given $2,000. You are now asked to choose between:
> A_2: A sure loss of $500, and
> B_2: A 50% chance to lose $1,000 and a 50% chance to lose nothing.

Kahneman and Tversky find that 84% of subjects chose A_1, the sure amount, in the first problem set. Yet, 69% of subjects chose B_2, the gamble, in the second problem set. This pattern of choice is puzzling within standard finance, because standard finance investors base their decisions on net cash flows and are never confused by frames. Yet, problem sets 1 and 2 are, in fact, identical in net cash flows.

Observe that once the initial $1,000 is integrated into the choice between A_1 and B_1 in problem 1, the overall choice is between:

> A_3: A sure gain of $1,500 (the sum of the initial $1,000 and the sure $500), and
> B_3: A 50% chance to gain $2,000 and a 50% chance to gain $1,000.

Similarly, once the initial $2,000 is integrated into the choice between A_2 and B_2 in problem 2, the overall choice is between:

> A_4: A sure gain of $1,500, and
> B_4: A 50% chance to gain $2,000 and a 50% chance to gain $1,000.

The two problems are identical in net cash flows.

EXHIBIT 1B
PROSPECT FUNCTION

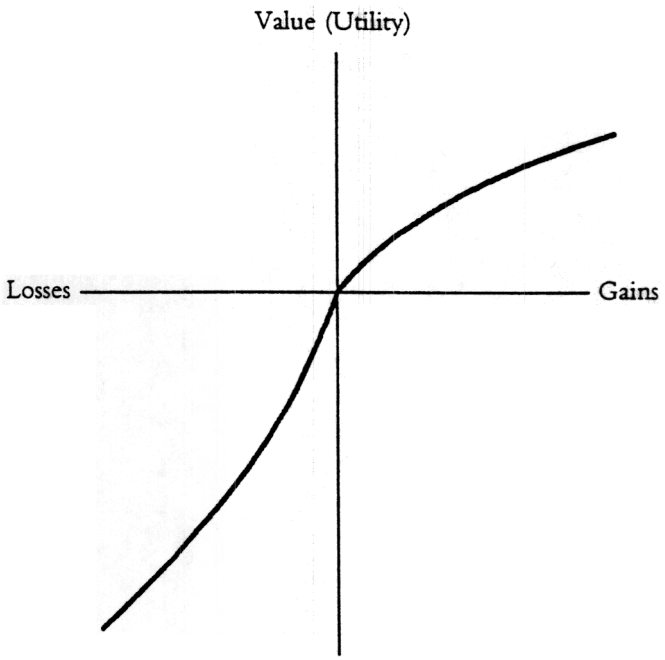


EXHIBIT 2
Dollar-Cost Averaging

Period	Amount Invested	Price per Share	Number of Shares Bought
	$1,000	$50.00	20
2	$1,000	$12.50	80
Total	$2,000		100
Average Cost of Shares Held:		$2,000/100 = $20	
Average Price per Share Over the Two Periods:		(50 + 12.5)/2 = $31.25	

Most of Kahneman and Tversky's subjects could not possibly be standard finance investors. Rather, they are behavioral finance investors. Prospect theory postulates that two distinct cognitive operations lead to choice, and that these two operations are sequential. First is framing into mental accounts. Second is the application of specific decision rules to the accounts.

The initial amount, $1,000 in problem 1, is stripped away and framed into a separate account. Problem 1 is then framed in terms of gains and losses relative to a reference point of zero. The concave portion of the prospect function in the domain of gains leads to a preference of the sure $500 gain over the gamble, a choice consistent with risk aversion. In problem 2, the convex portion of the prospect function in the domain of losses leads to a preference of the gamble over the sure $500 loss, a choice consistent with risk-seeking.

Consider now framing and choice in the context of dollar-cost averaging. Imagine an investor who divides $2,000 in cash into two segments of $1,000 each, investing one in period 1 and the second in period 2. The price per share of stock in period 1 is $50, and it turns out that the price per share in period 2 is $12.50. The data are presented in Exhibit 2.

Framing the problem in the standard finance way, the investor started with $2,000, and now has 100 shares worth $12.50 apiece for a total of $1,250. The investor has a clear loss.

Framing the problem as the proponents of dollar-cost averaging would have it, the investor bought the shares at an average cost of $20, while the average price per share over the two periods was $31.25. The investor has a clear gain. Indeed, framed in the behavioral way, the problem shows a gain in all cases except when the stock price never changes. It is absolutely true that the behavioral frame is misleading. It is equally true that the behavioral frame persists.

Unfortunately, there is no comprehensive theory that explains what makes some frames more compelling the others. (See Fischhoff [1983].) However, the persistence of the behavioral frame of dollar-cost averaging is hardly unique. Consider the public discussion about derivatives. Some finance practitioners and academics frame derivatives in the standard finance way and know that derivatives can be used with equal effectiveness to increase risk or to reduce it. But framing derivatives such that they always increase risk is a common practice, hardly limited to politicians.

A prominent feature of dollar-cost averaging is that it is recommended with equal force to investors with cash who consider converting cash into stock and investors with stock who consider converting stock into cash. This feature is useful in highlighting the difference in framing and choice between standard finance and behavioral finance.

Constantinides [1979], who analyzes dollar-cost averaging within the framework of standard finance, writes:

> Where, then, does the intuitive rationale of dollar-cost-averaging fail? Its rationale is that the investor replaces one major gamble on a temporary shift of prices by a number of smaller gambles and thus diversifies risk. The fault of this argument is misrepresentation of the state of the world, before a decision is made. Dollar-cost-averaging implies that an investor with all his endowment in asset A is in some way different from an investor with all his endowment in asset B, but otherwise identical. Dollar-cost-averaging ignores the simple fact that the latter investor may costlessly convert his endowment from asset A to asset B before he considers the optimal investment decision. Both investors face the same prospects irrespective of the composition of their endowment, and any claims of gambles on temporarily overpriced or underpriced prices are simply fallacious (pp. 447-448).

Imagine two investors, A and B, who are identical except that A has $1,000 in cash and B has $1,000 in stocks. A faces a choice between keeping his wealth

in cash or converting it into stock while B faces a choice between keeping her wealth in stock or converting it into cash. Framed in the standard finance way, the choice problems of A and B are identical because B can costlessly convert her initial stock endowment into cash. Therefore, their choices are predicted to be identical.

The frames and choices of A and B are likely to be different within the framework of behavioral finance. The two are identical in their beliefs, so they agree that the return on cash is zero, and that the value of stocks at the end of the period will, with equal probabilities, either increase to $1,300 or decrease to $860. The expected gain on stocks is $80, while the expected gain on cash is zero.

How would A frame the choice? Assume that the reference point for A is the $1,000 in cash, a position he has adapted to, and that he frames the choice in terms of gains and losses relative to the $1,000 reference point. If so, the choice is between:

Cash	A.	A sure gain of zero, and
Stock	B.	A 50% chance to gain $300 and a 50% chance to lose $140.

Assume that the reference point for B is $1,000 in stocks, a position she has adapted to. If so, the choice is between

Cash	A.	A 50% chance for an (opportunity) gain of $140 and a 50% chance for an (opportunity) loss of $300, and
Stock	B.	A sure (opportunity) gain of zero.

The problems faced by A and B are framed differently, and the choices are thus likely to differ. The concavity of the prospect function in the domain of gains, and the convexity of the prospect function in the domain of losses, is likely to cause A to hold onto his cash, and it is likely to cause B to hold onto her stock.[1]

The purported advantages of dollar-cost averaging involve, as Constantinides demonstrates, misleading frames. Framed in the standard finance way, a dollar-cost averaging investor only replaces one major gamble, embedded in a lump-sum investment, with a number of smaller gambles, embedded in dollar-cost averaging. But frames are important, and they affect choice.

AVERSION TO REGRET

The purchase of stock for $1,000 will result in $1,300 at the end of the period, or it will result in $860. The monetary gain is $300, and the monetary loss is $140, but monetary gains and losses are not all that affects choice. The joy of pride and the pain of regret matter. Kahneman and Tversky [1982] describe regret as the frustration that comes, ex post, when a choice results in a bad outcome.

If the $1,000 purchase of stocks results in $1,300, the $300 monetary gain is supplemented with the pride that comes from what is framed as buying $1,300 worth of stock for $1,000. If the $1,000 purchase of stocks results in $860, the $140 monetary loss is supplemented with the regret that comes from what is framed as buying $860 worth of stock for $1,000.

The distinction between 1) gains and losses in terms of money and 2) gains and losses in terms of pride and regret is akin to Thaler's [1985] distinction between acquisition utility and transaction utility. In Thaler's framework, the total utility of the purchase is composed of acquisition and transaction utilities. Acquisition utility depends on the difference between the value of the product and the outlay. Transaction utility depends on the "bargain" value of the purchase. In this framework, the bargain value corresponds to pride and regret.

Standard finance investors are affected by neither pride nor regret. Pride and regret, however, do matter to behavioral investors. If the joy of pride is equal to the pain of regret, behavioral investors who choose stock over cash without considerations of pride and regret would not alter their choice once pride and regret are introduced. If the pain of regret is sufficiently larger than the joy of pride, however, behavioral investors would choose to keep their holdings in cash rather than suffer the pain of regret that will come if stock prices decline.

Kahneman and Tversky note that there is a close association between regret and the level of responsibility for a choice. Actions taken under duress entail little responsibility and bring little regret. Following a rule is one way to reduce responsibility. Choice under a strict rule is choice under duress. Dollar-cost averaging involves a strict rule that specifies amounts to be invested at particular points of time. The ability of a dollar-cost averaging plan to reduce responsibility is especially helpful for investors who are concerned about their exposure to regret.[2]

COGNITIVE ERRORS AND SELF-CONTROL

Dollar-cost averaging is a non-sequential or non-contingent investment policy. The non-sequential nature of dollar-cost averaging is manifested in a commitment at the initiation of the plan to invest a particular amount in each subsequent period, regardless of any information that might become available after the initiation of the investment plan. Constantinides [1979] notes that the non-sequential nature of dollar-cost averaging is considered by its proponents as the key to its success.

Constantinides [1979] shows that dollar-cost averaging is dominated by a sequential optimal investment policy, a policy that takes into account information that arrives after the initiation of the investment plan. He adds that, in light of this result, it seems ironic that proponents of dollar-cost averaging go to great lengths to emphasize that investors must have the courage to ignore new information as they follow the inferior non-sequential investment policy.

A policy that is suboptimal within standard finance might nevertheless be attractive to behavioral investors. One advantage of the non-sequential nature of dollar-cost averaging for behavioral investors is that the non-sequential rules of dollar-cost averaging reduce responsibility and regret. But the advantage of following rules extends beyond a reduction in responsibility. The rules of dollar-cost averaging serve to combat lapses in self-control as cognitive errors influence investors to terminate their investment plans.

To understand the roles of self-control and cognitive errors, consider the description of dollar-cost averaging by Cohen, Zinbarg, and Zeikel [1977], quoted by Constantinides [1979]:

> The important thing is to stick to your schedule—to buy, even though the price keeps falling, which, psychologically, is usually hard to do.... To engage in dollar-cost-averaging successfully, you must have both the funds and the courage to continue buying in a declining market when prospects may seem bleak.

As Cohen, Zinbarg, and Zeikel note, investors find it difficult to continue to buy stocks following stock price declines. But why do investors find it difficult? The answer is that investors generally believe that recent trends in stock prices will continue.

The tendency of investors to extrapolate recent trends in stock prices is a reflection of representativeness, a cognitive error, and that tendency is well-documented. For example, Solt and Statman [1988] find that investment advisors become optimistic about the prospects of stocks after increases in stock prices and pessimistic after declines. They also find that there is no relationship between the sentiment of investment advisors at one particular time and the performance of the stock market in the subsequent period.

Suppose a dollar-cost averaging investor starts the investment plan with the expectation that there is an equal chance for an up-market or down-market in the coming period. Once several down-periods occur, the investor revises the probabilities so that the probability of a down-market is higher. The investment plan that was attractive by the old probabilities might no longer be attractive by the new ones, and the investor might choose to abandon the plan and stop buying stocks. Here is where the self-control role of dollar-cost averaging is most important.

Investors who allocate funds between savings and consumption often face difficulties because consumption is tempting. Rules are useful in enforcing a savings plan. Shefrin and Statman [1984] show how rules such as "consume from dividends, but don't dip into capital" help investors manage the self-control problem when a myopic "agent" within the individual wants to consume now, but a forward-looking "principal" considers savings for the future as well as current consumption. "Don't dip into capital" is a rule that the principal uses to constrain the consumption of the agent.

The task of the principal in enforcing savings is especially difficult after a period of losses, which is when the strict rules of dollar-cost averaging are most effective. The rules of dollar-cost averaging help investors "continue buying in a declining market when prospects may seem bleak."

CONCLUSIONS

Investors who employ dollar-cost averaging have their wealth in one asset, such as cash, and consider transferring it into another asset, such as stock. They can transfer wealth from one asset to the other in a lump sum. Instead, they transfer wealth in increments over time according to a predetermined plan.

It has been known at least since Weston [1949]

that the practice of dollar-cost averaging is inconsistent with standard finance. Yet dollar-cost averaging seems as popular today as ever. The persistence of dollar-cost averaging is an embarrassment to the role of standard finance as a positive theory of financial behavior.

Dollar-cost averaging is significant even if it is followed only by small investors, as the aggregate of small investors is large. Moreover, the early literature on dollar-cost averaging, such as Cottle and Whitman [1950], suggests that dollar-cost averaging plans were then popular among institutional investors. There is no evidence of a decline in that popularity.

Dollar-cost averaging is consistent with the positive framework of behavioral finance. I have described the role of four elements of the theory: prospect theory, aversion to regret, cognitive errors, and self-control. Choices that involve transfers of wealth among assets are framed and evaluated within prospect theory to show that dollar-cost averaging transfers are appealing to investors who find lump-sum transfers unappealing. Considerations of pride and regret affect transfers of wealth among assets. The susceptibility to cognitive errors, in particular the tendency to extrapolate recent trends in stock prices, explains why investors find it difficult to continue dollar-cost averaging plans after a period of stock price declines, and the need for rules to facilitate self-control explains the non-sequential nature of the rules that govern dollar-cost averaging.

Dollar-cost averaging joins financial products such as covered calls and LYONs, described by Shefrin and Statman [1993], as products that fit poorly with standard finance yet fit well with behavioral finance. Indeed, it belongs in the general area of portfolio construction. Shefrin and Statman [1995a] show that investors generally construct portfolios in ways that deviate from standard finance theory but are consistent with behavioral finance.

Much of dollar-cost averaging takes place in a framework where choice is not explicit. A feature of the implementation of defined-contribution pension plans, such as 401(k)s, is that employers and employees contribute cash to the pension plan on each payroll date, and the cash contribution is converted on that date into stocks or bonds. Any choice between lump-sum and dollar-cost averaging in defined-benefits pension plans, however, is only implicit because employees are not given an explicit choice between contributions in portions over the cause of a year and a lump-sum contribution at a point during the year.

Suppose an employer does offer employees a choice between dollar-cost averaging contributions coinciding with payroll days during a year and a one-time lump-sum contribution of the total annual amount so that the present values of the cash flows in the two options are identical. The prediction of standard finance is that employees will be indifferent between the dollar-cost averaging option and the lump-sum option. The prediction of behavioral finance is that employees would prefer the dollar-cost averaging option. While I know of no employer who offers such a choice at present, it should be possible to test this hypothesis in an experiment.

While my focus here is on investor behavior, not on security prices, the practice of dollar-cost averaging has important implications for pricing. It is by now well established that investment flows, even in the absence of information, affect prices. For example, the work of Warther [1994] reveals a strong link between cash flows into and out of mutual funds and the returns to stocks held by the funds. Investors who practice dollar-cost averaging are more likely than other investors to continue to buy stocks after a period of declines in stock prices and less likely to accelerate buying after a period of increases in stock prices. I hypothesize that an increase in dollar-cost averaging leads to a decrease in volatility.

Dollar-cost averaging is indeed suboptimal within the choice set facing a fully rational investor in standard finance. But the interpretation of rationality is a delicate task. Consider, for example, the equity risk premium (Mehra and Prescott [1985]). The existence of an equity premium puzzle suggests that investors invest too little in stock, and investment advisors might wish to guide their clients to convert some cash into stock.

Compare an advisor who counsels a client to convert cash into stock in a lump sum to an advisor who counsels the client to use dollar-cost averaging. Lump-sum conversion from cash to stock might be optimal, but such conversion is unappealing to investors who are deterred from action as they contemplate the regret that they will experience if the stock market were to crash as soon as the cash is converted into stock. Dollar-cost averaging is indeed a second-best solution, but it might start an investor on a road that leads to allocation of a portion of wealth to stocks.

As Samuelson [1994] writes about dollar-cost averaging, he notes that it is one of dozens of rules

whose merit has nothing to do with improving risk-adjusted returns or mean-variance optimization. He adds that, at least for fiduciary trustees, using such rules is a blunder, if not a crime. Yet the fact that many common investment rules are inconsistent with standard finance is evidence that standard finance does not do well as a positive theory.

Standard finance is inconsistent with the existence of an investment advising industry where rules such as dollar-cost averaging are a mainstay. Standard finance is inconsistent with the existence of a mutual fund industry where, on average, money managers fail to outperform indexes (see Malkiel [1995]), and standard finance is inconsistent with the existence of an investment newsletter industry where newsletter writers provide useless asset allocation advice (see Graham and Harvey [1995]).

It might be time to move on to a positive theory that is consistent with the evidence, and to remember that a normative theory is useless if investors cannot be persuaded to follow it. Meanwhile, I offer an hypothesis. The practice of dollar-cost averaging will persist.

ENDNOTES

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[1]The choice problem of B is equivalent to the choice problem of a money manager whose performance is evaluated relative to a benchmark identical to B's portfolio. The benchmark serves as the reference point, and gains and losses are measured relative to it. (See Roll [1992] and Clarke, Krase, and Statman [1994].)

[2]For a "mini-max" policy, where considerations of regret lead investors to choose dollar-cost averaging, see Pye [1972].

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