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Pension Design and Structure

New Lessons from Behavioral Finance

EDITED BY

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Chapter 4

Behavioral Portfolios: Hope for Riches and Protection from Poverty

Meir Statman

As the boom of the late 1990s gave way to the bust of the early 2000s, and defined benefit (DB) plans gave way to defined contribution (DC) plans, individual investors struggled to understand their responsibilities and look for help from employers, financial services companies, government entities, investment professionals, and academics. We argue in this chapter that behavioral portfolio theory offers a good description of investor behavior and a basis for good policy prescriptions.

Behavioral portfolio theory is an alternative to mean–variance portfolio theory, a theory that is founded on expected utility theory (Shefrin and Statman, 2000). Van Neumann and Morgenstern (1944) developed expected utility theory from Bernoulli utility theory, the principles of which are illustrated in the observation that most people prefer a sure $1 over a gamble with the same expected value, such as one that offers a 50 percent chance to win $2 and a 50 percent chance to win nothing. Expected utility theory says that the utility of money increases at a lower rate than its amount, as depicted in the concave Bernoulli utility function graphed in Figure 4-1. So, while the expected value of the 50–50 gamble for $2 or nothing is equal to a sure $1, its expected utility is less than the utility of a sure $1. The observation that people generally prefer a sure $1 over a gamble with the same expected value has been offered as evidence that people are risk-averse.

Expected utility theory and mean–variance portfolio theory banished risk-seeking and gambling from theory, but gambling is easier to banish from theory than from real life. The Commission on the Review of National Policy toward gambling (1976) in *Gambling in America* describes the attempts of the Christian church to banish gambling in the early days of Christianity:

> Gambling was forbidden to early Christians, but an evasion of the code continued for centuries, extending often to the clergy itself. Constantinople, the seat of the Church, was also the 12th Century gambling capital of the world. (p. 5)

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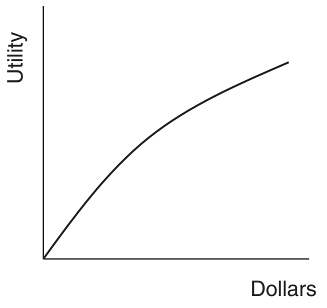

Figure 4-1. Bernoulli's utility function.
Source: Lopes (1987).

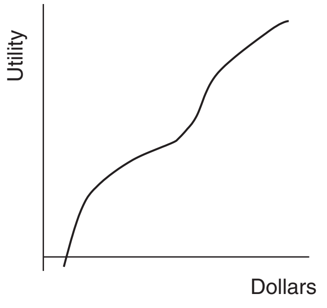

Figure 4-2. Friedman–Savage's utility function.
Source: Lopes (1987).

Centuries later, the Dickenson Report, part of the deliberations leading to the 1934 Securities Act, said (Ellenberger and Mahar, 1973):

> It must always be recognized that the average man has an inherent instinct for gambling in some form or other. It has been recognized as a social evil, always inveighed against since early times. No method of combating it has ever been completely successful.

The road to behavioral portfolio theory started more than a half century ago, when Friedman and Savage (1948) noted that hope for riches and protection from poverty share roles in our human behavior; people who buy lottery tickets often buy insurance policies as well. Consequently people are risk-seeking enough to buy lottery tickets in the concave middle portion of their utility function (see Figure 4-2), while they are risk-averse enough to buy insurance in the convex outer portions. Four years later, Markowitz wrote two papers that reflect two very different views of behavior. In one (1952*b*), he created mean–variance theory, based on expected

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utility theory; in the other (1952*a*), he extended Friedman and Savage's insurance–lottery framework. People in mean–variance theory, unlike people in the insurance–lottery framework, would never buy lottery tickets; they are always risk averse, never risk-seeking.

Friedman and Savage observed that people buy lottery tickets because they aspire to reach higher social classes, whereas they buy insurance as protection against falling into lower social classes. Markowitz (1952*b*) fine-tuned the Friedman/Savage observation by noting that people aspire to move up from their *current* social class or "customary wealth." So people with $10,000 might accept lottery-like odds in the hope of winning $1 million, and people with $1 million might accept lottery-like odds in the hope of winning $100 million (see Figure 4-3). Kahneman and Tversky (1979) extended this line of research into prospect theory, which describes the behavior of people who accept lottery-like odds when they are below their levels of aspiration, but reject such odds when they are above their levels of aspiration (Figure 4-4).

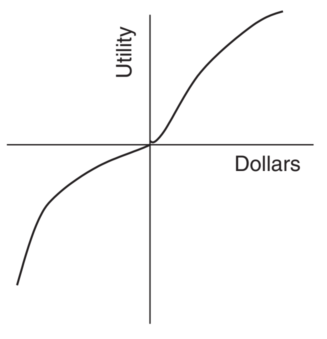

Figure 4-3. Markowitz's customary wealth utility theory.
Source: Lopes (1987).

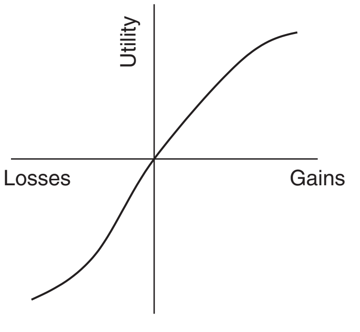

Figure 4-4. Kahneman and Tversky's prospect theory utility function.
Source: Lopes (1987).

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Prospect theory is different from expected utility theory and mean–variance theory in a number of ways. First, while mean–variance consumers choose among alternatives based on effect of outcomes on the *levels* of their final wealth, people in prospect theory choose based on the effect of outcomes on *changes* in their wealth, relative to their reference point. Markowitz's "customary wealth" is a common reference point. Second, while mean–variance consumers are always risk-averse, people in prospect theory are risk-averse when changes in wealth are perceived as gains, but they are risk-seeking when all changes in wealth are perceived as losses. Third, mean–variance consumers treat risk objectively, by its probabilities, but prospect theorists overweight small probabilities. Overweighting may cause people to be risk-seeking in the domain of gains, such as when they purchase lottery tickets, or it may cause them to be risk-averse in the domain of losses, such as when they purchase insurance against losses that have small probabilities, such as when they buy insurance against plane crash at the airport, just before they board their flight. Finally, mean–variance theory assumes that frames do not affect choice, prospect theory emphasizes that frames greatly affect choices.

Consider an experiment that illuminates the features of prospect theory. Imagine that you face a choice of a pair such that one is A or B and the other is C or D, where

- A = a sure gain of $24,000
- B = a 25 percent chance to gain $100,000 and a 75 percent chance to gain nothing
- C = a sure loss of $75,000
- D = a 75 percent chance to lose $100,000 and a 25 percent chance to lose nothing.

The evidence shows that more people chose A than B, and more people chose D than C. This common pattern poses a puzzle for mean–variance theory, since people are predicted to be risk-averse in mean–variance theory, never risk-seeking. While the choice of A over B is consistent with risk-aversion, the choice of D over C is not. Note that the $25,000 expected gain of B (25 percent of a $100,000 gain) is greater than the sure $24,000 gain of A, so the common choice of A over B is consistent with risk-aversion. However, the election of D over C indicates that such people behave as if they are risk-seeking. Note that the expected $75,000 loss of D (75 percent of a $100,000 loss) is equal to the sure $75,000 loss of C, but D is riskier than C since it can impose a $100,000 loss.

One reason for this analysis is that choices depend on frames. For example, the common choice of the A and D combination is stochastically dominated by the less frequently chosen B and C. Note that A and D offers a 25 percent chance to win $24,000 and a 75 percent chance to lose $76,000, while B and C offers a 25 percent chance to win more, $25,000, and a 75 percent chance to lose less, $75,000. Even though the instructions indicate that the choice among A, B, C, and D is concurrent, people tend to frame the choice into one from A and B and one from C or D, overlooking the link between the two choices and its relationship to the final levels of their wealth. Indeed, researchers found that when people are asked directly whether they would prefer winning $25,000 instead of winning $24,000, and losing $75,000 instead of losing $76,000, all chose the more favorable amounts, the amounts associated with the stochastically dominating B and C.

In general then, in the context of portfolio construction, these findings imply that people do not choose well-diversified portfolios. In particular, people ignore covariance among security returns, and therefore choose stochastically dominated portfolios that lie below the mean–variance efficient frontier.

Behavioral Portfolio Theory

A central feature in behavioral portfolio theory is the observation that investors view their portfolios not as a whole, as prescribed by mean–variance portfolio theory, but as distinct layers in a pyramid of assets, where layers are associated with particular goals and where attitudes towards risk vary across layers.[1] One layer might be a "downside protection" layer, designed to protect investors from being poor. Another might be an "upside potential" layer, designed to give investors a chance at being rich. Investors might behave as if they hate risk in the downside protection layer while they behave as if they love risk in the upside potential layer. These are normal, familiar investors, investors who buy insurance policies while they also buy lottery tickets.

In the simple version of behavioral portfolio theory, investors divide their money into two layers, a downside protection layer designed to protect them from poverty, and an upside potential layer designed to make them rich. Investors in the complete version of the theory divide their money into many layers corresponding to many different goals and levels of aspiration.

Seeing behavioral portfolios as pyramids of assets is consistent with investment advice. Consider, for example, the investment pyramid that the Putnam mutual fund company (Putnam Investments, 2003) prescribes to its investors, presented in Figure 4-5. Income funds in the Putnam Pyramid are "[d]esigned to provide a regular stream of income," and their place is at the bottom of the pyramid, while growth funds are "[d]esigned to help build the value of your investment over time," and their place is at the top of the pyramid. This structure is also reflected in the upside potential and downside protection layers of "core and satellite" and "risk budget" portfolios. Pietranico and Riepe (2002) describe "Core and Explore," Schwab's version of core and satellite, as comprised of a well-diversified "core," serving as the

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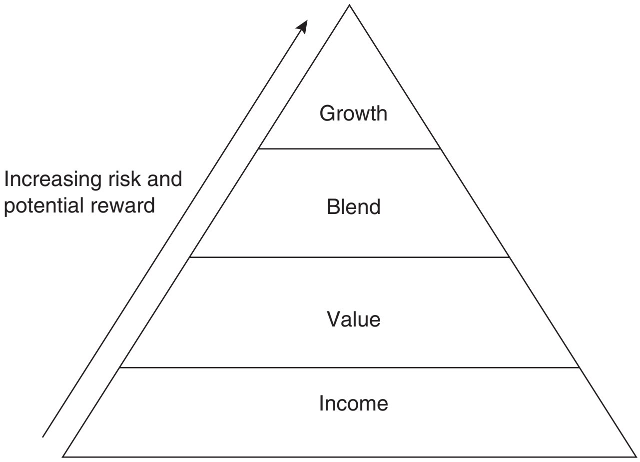

Figure 4-5. Portfolios as layered pyramids.
Source: Putnam Investments (2003).

"foundation" layer of the portfolio and a less diversified layer of "explore," seeking "returns that are higher than the overall market, which entails greater risk." Similarly, Waring et al. (2000) describe portfolios where the risk budget is allocated to active funds while the safe budget is allocated to index funds.

One might argue that while portfolios are described as layered pyramids consistent with behavioral portfolio theory, investors consider them as a whole, consistent with mean–variance portfolio theory. But such argument is not supported by the evidence. Consider, for example, Question 13 in Fidelity Investments (2003) Asset Allocation Planner:

If you could increase your chances of improving your returns by taking more risk, would you:

1. Be willing to take *a lot* more risk with *all* your money.
2. Be willing to take *a lot* more risk with *some* of your money.
3. Be willing to take *a little* more risk with *all* your money.
4. Be willing to take *a little* more risk with *some* of your money.
5. Be unlikely to take much more risk.

Answers 1 and 3 make sense within the mean–variance framework. In that framework, only the risk of the overall portfolio (i.e. *all* your money) matters. But answers 2 and 4 make no sense within the mean–variance framework. This is because answers 2 and 4 segment the portfolio into layers where investors are willing to take *a lot more risk* or *a little more risk* with *some* of their money. Mean–variance investors have single attitude toward risk, not a set of attitudes, layer by layer. In contrast, behavioral investors have many attitudes toward risk, layer by layer. So they might be willing to take *a lot more* risk with *some* of their money.

Mean–variance investors construct the mean–variance efficient frontier by identifying portfolios with highest level of expected wealth for each level of standard deviation. The counterpart in behavioral portfolio theory to standard deviation in mean–variance portfolio theory is the probability that wealth might fall below the aspiration level. Behavioral investors construct the behavioral efficient frontier by identifying the portfolios with the highest level of expected wealth for each probability that wealth would fall below the aspiration level (see Figures 4-6a and b).

Mean–variance portfolio theory posts that security returns follow a normal distribution, but that behavioral investors prefer securities with non-normal, asymmetric distributions that combine downside protection, in the form of a floor, with upside potential (Shefrin and Statman, 2000). Call options combine a floor with upside potential and so do bonds, stocks,

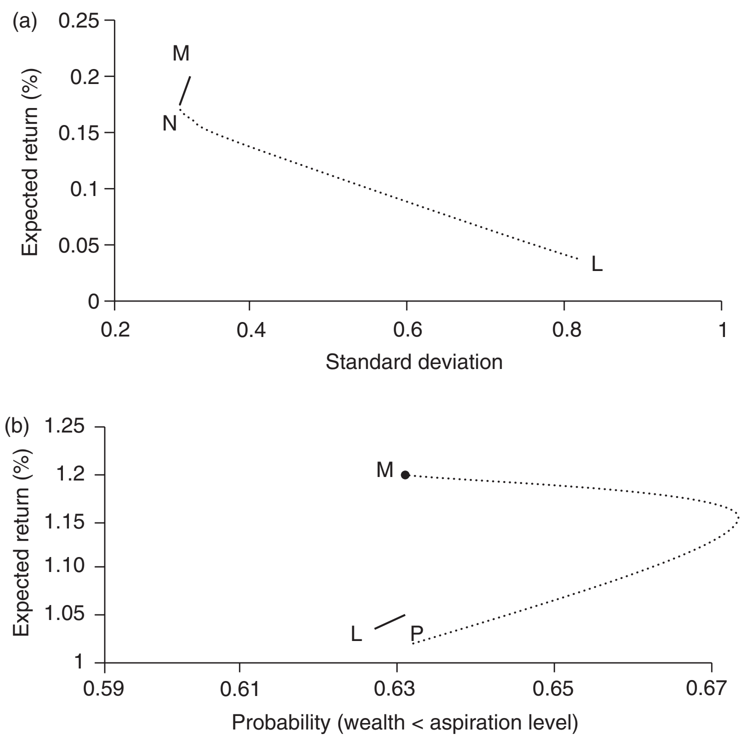

Figure 4-6. (a) Mean–variance and (b) behavioral efficient frontiers with $1.00 in assets and a $1.30 aspiration level.

Source: Shefrin and Statman (2000).

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and lottery tickets. Indeed, "limited liability" is an important feature that endears stocks to the hearts of behavioral investors. Behavioral investors choose "deep in the money" securities, such as Treasury bills, bonds and equity participation notes for the downside protection layers of their portfolios, "in the money" securities, such as stock mutual funds and individual stocks, for the middle layers of their portfolios and "out of the money" securities, such as call options and lottery tickets for the upside potential layers of the portfolios.

While securities with normal distributions are not optimal for behavioral investors, they do provide a comparison between behavioral efficient frontiers and mean–variance efficient frontiers when investors can choose only from securities with normal distributors (Shefrin and Statman, 2000). Behavioral investors, like mean–variance investors, tend to consider their portfolio as a single account, so behavioral investors with low aspirations are likely to choose diversified portfolios, while those with high aspirations are likely to choose undiversified portfolios. Moreover, behavioral investors with high aspirations are likely to choose lottery-like securities, shunned by mean–variance investors.

Consider an investor with $1 and a (high) aspiration level of $1.30 who can choose security L, security M, or combinations of both. Security L is lottery-like, with an expected return of 2 percent and a standard deviation of 90 percent, while security M has an expected return of 20 percent and a standard deviation of 30 percent.[2] The mean–variance efficient frontier extends from M to N in Figure 4-6(a), where N is the portfolio with the lowest standard deviation. Mean–variance investors with no aversion to risk place their entire $1 in security M, while risk-averse mean–variance investors divide their $1 between securities M and L along the M–N efficient frontier. Yet, a portfolio composed entirely of lottery-like L is not on the mean–variance efficient frontier, because it is dominated by other portfolios, including the one composed entirely of M. In contrast, a portfolio composed entirely of L is on the efficient frontier of a high-aspiration behavioral investor, since it provides the highest probability of reaching the aspiration level. The behavioral efficient frontier extends from L to P and includes M. The probability of reaching the aspiration level in P is higher than the probability in M, but M offers higher expected returns than P (see Figure 4-6b).[3]

Behavioral investors who choose lottery-like L do so because they have high aspirations, not because they like risk. In that, they are similar to the Dubins and Savage (1976) investor who is in a casino with $1,000 and desperately aspires to have $10,000 by morning. The optimal portfolio for this investor is concentrated in a single bet, one that offers a chance, however small, of winning $10,000. An investor who diversifies his bets does worse than one who concentrates them in a single bet since he has virtually no chance of winning the aspired $10,000.

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While the single account version of behavioral portfolio theory is useful for comparisons with mean–variance portfolio theory, investors in practice think of their portfolio not as a single account but as a pyramid of many accounts or many layers. In the two-layer version of behavioral portfolio theory, investors divide their portfolio money into a downside protection layer with a low aspiration level, designed to protect them from poverty, and an upside potential layer with a high aspiration level, designed for a shot at riches. A diversified portfolio of cash, bonds, and stock mutual funds comes close to an optimal sub-portfolio for the downside protection layer while an undiversified portfolio consisting of one or a few stocks comes close to an optimal sub-portfolio for the upside potential layer. The overall portfolio where the two layers are added together is likely to contain large proportions of one or few stocks.

Consider an investor who is pulled equally strongly by the desire for downside protection and the desire for upside potential so he divides his $2 into two equal parts, $1 for the downside protection layer and $1 for the upside potential layer. Imagine that the aspiration level of that investor for the downside protection layer is $1, a level that is low relative to the $1.20 aspiration level for the upside potential layer. Imagine that there were two securities, X and Y, both of which have normally distributed returns. X has an expected return of 16 percent with a standard deviation of 20 percent, while Y has an expected return of 10 percent with a standard deviation of 15 percent. The correlation between the returns of X and Y is zero.

Now we contemplate behavioral efficient frontier for the downside protection layer. A portfolio consisting entirely of Y offers an expected wealth of $1.10 along with a 25.2 percent probability that the aspiration level will be missed. Portfolio Y is not on the efficient frontier since it is dominated by portfolio Z. Portfolio Z, combining $0.50 of X with $0.50 of Y, has the lowest probability of missing the aspiration level, 14.9 percent, along with higher expected wealth, $1.13. Figure 4-7 shows the efficient frontier for the downside protection layer, extending from Z to X. Next, consider the efficient frontier for the upside potential layer. Figure 4-8 shows that the frontier consists of a concentrated bet on security X. Any other portfolio is inferior since it provides a lower expected wealth with a higher probability of missing the aspiration level.

In sum, behavioral investors allocate their assets to upside potential and downside layers of a portfolio pyramid. While they place great importance on the upside potential layers of their portfolios, they do not necessarily neglect the downside protection ones. Indeed, behavioral investors form their portfolios as if they fill the downside protection layers of their portfolios first, before they move on to fill the upside potential ones. Many gamblers do the same. *Gambling in America* (1976) reported that gamblers have more substantial downside protection layers than non-gamblers and the proportions of both stock owners and bond owners among gamblers is

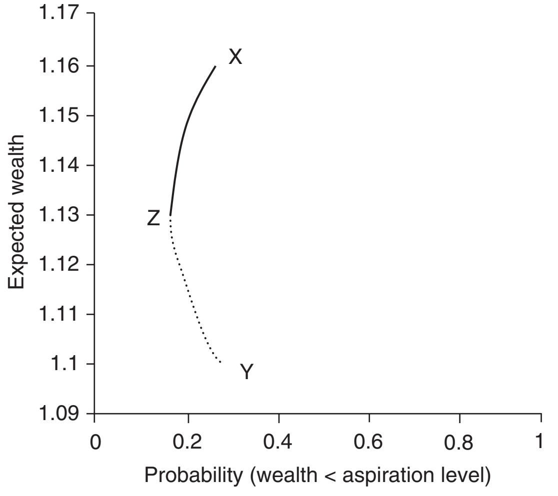

Figure 4-7. Behavioral efficient frontier for an investor with $1.00 in the downside protection layer and a $1.00 aspiration level.

Source: Shefrin and Statman (2000).

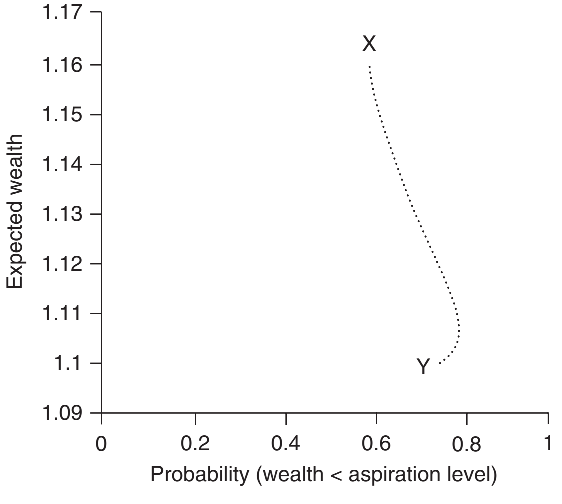

Figure 4-8. Behavioral efficient frontier for an investor with $1.00 in the upside potential layer and a $1.20 aspiration level.

Source: Shefrin and Statman (2000).

higher than their proportions among non-gamblers. Moreover, "gamblers were more likely to have their future secured by social security and pension plans than non-gamblers and hold 60 percent more assets . . . " (1976: 66).

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Public Policy

Mean–variance theory offers portfolio descriptions that investors do not follow. By contrast, behavioral portfolio theory offers descriptions of pyramid portfolios that are much closer to reality. Investors want downside protection layers in their portfolios but they want upside potential layers as well. But what should we prescribe as the right balance between upside potential and downside protection? And what should we prescribe as the right balance between freedom and paternalism?

One problem is that people have begun suing advisers and employers who let them concentrate their portfolios in stocks. Mitchell and Utkus (2003) illustrate the tradeoff between upside potential and downside protection in their discussion of the consequences of holding company stocks in DC plans. They simulated three hypothetical portfolios, one invested entirely in company stock, one invested entirely in a stock market index, and one divided equally between company stock and stock market index. They found that portfolios concentrated in company stock offer great upside potential, with a 5 percent chance of accumulating more than $4.1 million after 30 years. In contrast, the corresponding accumulation figure for the stock market portfolio is only $2.7 million. Yet, while the stock market index offered lesser upside potential, it offered greater downside protection. The lowest accumulation with the stock market index was $281,000 while the lowest accumulation with company stock was $66,000.

Should financial advisers, employers, and government entities let investors concentrate their portfolios in company stock? Should they let investors concentrate their portfolios in stocks? Public policy has always fluctuated between the desire for upside potential and the desire for downside protection, just it has fluctuated between the desire for freedom and the desire for paternalism. People opt for freedom when times are good and upside potential seems near, but evidence suggests they clamor for paternalism after it turns out that they have sacrificed downside protection for dashed hopes of upside potential.

This pattern has long historical roots in the United States. In the early 1900s, as investors pressed for "blue sky" laws when their reach for upside potential brought loss of downside protection. The value of Kansas farmland more than doubled during the 1900–10 period and this new prosperity attracted investment promoters. A commentator at the time noted (Bateman, 1973: 766): "the state of Kansas, most wonderfully prolific and rich in farming products, had a large proportion of agriculturists not versed in ordinary business methods. The State was the happy hunting ground of promoters of fraudulent enterprises; in fact, their frauds became so barefaced that it was stated that they would sell building lots in the blue sky in fee simple. Metonymically they became known as the blue-sky merchants and the legislation intended to prevent their frauds was called Blue Sky Law."

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The 1911 Kansas Blue Sky law empowered state officials to deny registration to any security judged unfair, unjust, or inequitable to any class of investors. By 1933, every state except Nevada had adopted blue sky laws. Carosso (1970: 164) noted the paternalistic nature of these laws, "Never before had a state sought to prevent its citizens from making unwise decisions." The paternalistic blue sky framework competed with the freedom-based disclosure framework as the basis for the 1933 and 1934 acts that established the SEC and underlie the regulation of investors and investments to this day. Congressman Huston Thompson took the leadership role in crafting a new securities law in 1933, shortly after President Roosevelt's inauguration and his draft combined blue sky features with disclosure ones.

Several argued against the blue sky features in Thompson's bill. Rayburn told Roosevelt that the Thompson bill was too stringent and Roosevelt quickly agreed, for two reasons: First, he wished to enact a securities bill rapidly and was concerned that a debate would delay enactment; and second, he felt most strongly about the disclosure principle. Disclosure is the principle that underlies the acts of 1933 and 1934, but paternalism has not been vanquished, reflected in Social Security.

Social Security was created to satisfy a need for downside protection. Moss (2002) wrote that the "Social Security Act represented a sweeping response to the problem of worker insecurity" and quoted President Roosevelt's words:

> We can never insure one hundred percent of the population against one hundred percent of the hazards and vicissitudes of life, but we have tried to frame a law which will give some measure of protection to the average citizen and to his family against the loss of a job and against poverty-ridden old age. (2002: 180)

Clearly, the pendulum has begun to swing from freedom to paternalism, as the boom of the late 1990s has given way to the bust of the early 2000s. Further, it appears that the pendulum is swinging from concern over upside potential to downside protection.

Conclusion

Over a half century ago, Friedman and Savage (1948) described people as they are, people who hope that a lottery ticket will lift them into a higher social class, while they trust that an insurance policy will protect them from falling into a lower social class. While Friedman and Savage assigned equal roles to lottery tickets and insurance policies in their insurance–lottery framework, research by Markowitz took us to a fork in the road (1952*a,b*). On one hand, Markowitz extended Friedman and Savage's framework, assigning to lotteries a role as big as the role of insurance. On the other, the mean–variance framework, Markowitz (1952*b*) assigned to lotteries no

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role at all. While the mean–variance road is the better-traveled road the insurance–lottery road is the better road. Here, we have shown how Kahneman and Tversky (1979) developed the thinking into prospect theory, while Shefrin and Statman (2000) pressed further to develop behavioral portfolio theory.

While some researchers and policymakers may lament the fact that people are attracted to lotteries, others might accept it and help people strike a balance between hope for riches and protection from poverty. Finding the balance is the challenge as governments offer to both Social Security and lotteries, corporations offer their employees both mutual funds and company stocks, and the financial services industry offers its investors both bond funds and Internet stocks.

Notes

[1] Friedman and Savage (1948), Markowitz (1952*b*), and Kahneman and Tversky (1979) form the basis of Shefrin and Statman's (2000) behavioral portfolio theory.
[2] The argument would be similar if the expected return of L were negative, as is the case of a lottery.
[3] Behavioral investors do not borrow to leverage their investments. Mean–variance investors without the ability to borrow might concentrate their portfolios in one security, but it would not be lottery-like stock L.

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