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IMPLICATIONS FROM EXPERIMENTAL BEHAVIORAL FINANCE FOR IMPROVING PORTFOLIO SELECTION

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EXECUTIVE SUMMARY

Evidence from experimental research in behavioral finance indicates that investors often have limited computational ability and/or limited attention. There is also debate regarding how choice under risk is actually made. This paper discusses the implications of such observations for improving asset allocation decisions.

The evidence on limited computational ability implies that investors will have difficulty making optimal choices when information requires complex processing, such as aggregating risks across investments or time. The implication for investment advisors is that information should be processed and presented in a format that simplifies optimal choices. For example, individual investments could be aggregated into portfolios instead of presented separately. Horizon specific return projections could be made instead of presenting annual return information. An advisor could ask for the investor's preferences across efficient portfolio choices instead of expecting investors to build efficient portfolios by themselves. These observations suggest, for example, that appropriately designed and communicated lifetime funds may improve investor choices.

Much experimental evidence regarding attention shows that people make decisions based on heuristics, or short-cuts, instead of considering all available information. Further, people pay attention to some kinds of information more than others. The implication for investment advisors is that the most important, decision-relevant information needs to be up front and clearly presented in a salient manner.

Finally, evidence suggests that the ways investors acquire and process information can be complicated. Further, investors may have a multi-dimensional view of risk and evaluate outcomes relative to fears, aspirations and other benchmarks such as the status quo. Recognition of such factors can help financial advisors improve outcomes. All of this research suggests that to give the best financial advice, advisors need to understand the way investors think about decisions and the process through which decisions are made.

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INTRODUCTION

Long-term financial planning is extremely important for lifetime financial security, but it is also exceptionally difficult for most investors. Investors' earnings, savings and investment choices determine their consumption and wealth across their lifetime. Investors face the "portfolio problem" when selecting investments as they save for future consumption.

For many investors, retirement plan sponsors are both the entrée to financial markets and a source of advice for long-run planning. Among other things, plan sponsors must decide the investment options offered to investors, the advice given to investors, and how that advice is tailored for individual investors. Appropriate advice requires, at a minimum, an expert understanding of the basic portfolio problem and an understanding of how investors make decisions in the real world.

A perpetual challenge for employers, financial advisors, and regulators is determining how best to assist investors in making optimal financial decisions. By improving decisions, financial advisors can improve lifetime financial security for investors. On the other hand, advice that is difficult to understand or advice that does not account for the behavioral decision-making processes of investors may actually make them worse off. In order to assist investors, it is important to understand how they process information and how they make investment decisions.

Traditional economic models assume investors are analytically sophisticated and knowledgeable about markets. By assumption, investors in such models make optimal decisions in a rational manner. However, even professional investors and economists do not always agree about how to specify and solve the problem that investors face. The average investor is less knowledgeable than professionals about the problem and has limited time and attention to devote to it. Understandably, investors may resort to rules-of-thumb, display biases, or behave "irrationally" in other ways. Not only does this make optimal long-term financial planning difficult for the average investor, but it presents challenges for advisors as well.'

This paper examines behavioral research on how investors think about aspects of the portfolio problem. It focuses on experimental studies that have examined various tasks associated with financial decision-making. The goal is to convey what is known and not known about investor behavior. In order to understand the research, it helps to understand some of the results from the standard economic model under traditional assumptions about how investors behave. It therefore begins by outlining that model for the asset allocation problem. Then, it discusses complicating factors from the real world and moves on to the evidence from experimental work in behavioral finance.

THE STANDARD PORTFOLIO PROBLEM

In standard economic models, investors understand the nature of the economic problem they face, understand how to solve the problem given appropriate information, and possess whatever information is required to solve the problem. Traditional models make assumptions about investor characteristics (e.g., preferences towards risk) that may or may not accurately reflect the true characteristics of investors. These models also ignore or simplify many practical issues relating to investment costs, information about assets, taxes, legal requirements, and the like.

In the simplest form of the portfolio problem, investors consume at two times: today and at a single future date. Whatever isn't consumed today is invested. The investor is risk-averse with respect to future consumption. A common assumption is that investors have "mean-variance utility," meaning that they receive higher utility from a greater expected return (higher mean) on the overall investment portfolio and lower utility from a greater variance of the return. To assess the expected return and variance of a given portfolio, the investor must know the average return of each asset in the portfolio, the variance of each asset return, and the covariance for every asset pair.

This problem seems overwhelming, but theory provides a simple solution—if all investors have the same information about assets and all have mean-variance utility, then all investors will select risky assets in the same relative proportions. This is the "mutual fund separation theorem," so called because a single mutual fund of risky assets will satisfy every investor. The portfolio choice problem then reduces to selecting how much to invest in the risk-free asset and how much to invest

in the portfolio of risky assets. The specific portfolio allocation will depend on the investor's risk tolerance. Risk-tolerant investors will invest relatively more in the risky portfolio; risk-averse investors will invest less in the risky portfolio.

This solution constitutes textbook financial advice. In this setting, the financial advisor should assess risk preferences and recommend the appropriate allocation between the portfolio of risky assets and the risk-free asset. This is the "baseline model."

BEHAVIORAL FINANCE

It is well-known that the baseline model does not accurately describe investor behavior. The finance literature, and the behavioral finance literature in particular, documents situations where investor behavior seems inconsistent with the baseline model. Many such anomalies are associated with the asset allocation problem. For example, it seems obvious that investors do not all hold stocks in the same relative proportions. This has been confirmed by a number of researchers (e.g., Blume et al. [1974] to Goetzmann and Kumar [2008]) who show that investors are typically under-diversified relative to the baseline model. Researchers also document a "home country" bias in which investors under-diversify across international borders (Lewis [1999]).

More subtly, Mehra and Prescott [1985] document an excessively high risk premium for equity investments, indicating that investors are unwilling to allocate investments to equity in spite of apparently high rewards for doing so. Calvet et al. [2007] also argue that investors do not allocate enough to equities and other risky investments. These are just a few of many examples.[1]

Often, inconsistencies with the baseline model are attributed to irrational investors. But, in the real world even the baseline model imposes immense informational and computational burdens on the investor. One can build a portfolio from a large universe of assets including stocks, corporate bonds, municipal bonds, Treasury securities, indexed funds, actively-managed funds, international funds, commodity funds, and various "alternative" investments. In theory, the investor must understand the investable set of assets and the statistical characteristics and interrelationships among these assets.

The investor also faces myriad real world complications, such as taxes, transaction costs, private information, uncertainty about life expectancy, correlations between the investor's labor income and asset returns, and uncertainty about return distributions. These considerably complicate the asset allocation problem for a given investor (see, for example, Ibbotson et al. [2007]). Investors also make decisions concerning insurance, education, employment and bequests. All of these decisions are influenced by the investor's health, marital status, skills, number and age of dependents, etc. As a result, the correlation structure across assets alone is not sufficient for an investor to make an allocation decision in the real world. Investors have to consider the correlations between assets and their own investor-specific decisions and attributes.

Due to this complexity, the full-blown financial planning problem is generally intractable for both investors *and* financial planners. Nevertheless, ultimately, all investors will make this financial decision, even if the choice amounts to passively accepting a default option, randomly choosing investments, or following rules of thumb.

What advice should be given in the face of such an intractable problem? First, real world asset allocation problems are sufficiently complex that there is no overall "optimal" financial advice that can be given to all investors. Nevertheless, financial advisors need to understand the baseline model because it develops useful general guidelines for investing (e.g., diversification reduces risk). Bodie and Crane [1997] present a list of such recommendations.

1 Other examples include:
- basing allocations on past performance in sub-optimal ways, including the "disposition effect" (Weber and Camerer [1998]), "performance chasing" (Moore et al. [1999]),
- excessive trading or "churning" of portfolios (Dorn and Huberman [2005] and Barber and Odean [2001]),
- optimistic biases and "wishful thinking" (Moore et al. [1999] and Forsythe et al. [1999]), among others. For more examples, see Thaler [1993], Thaler [2005], and references therein.

Second, given the range of specific situations, some investors will need advice specifically tailored to them. Such advice can be quite valuable to some investors. As a result, financial advisors need to understand the specific situations faced by investors. Third, financial advisors can help all investors improve their decisions by helping them avoid common pitfalls. As a result, financial advisors need to understand when investor behaviors are likely to result in investors making obviously sub-optimal choices.

The next section discusses evidence from experimental research in behavioral finance. This research studies behavior in controlled environments and shows that, sometimes, people display biases and make mistakes. If financial advisors can help investors avoid similar biases and mistakes in real world asset allocation decisions, they can improve the outcomes of their clients.

EXPERIMENTAL EVIDENCE

The baseline model tells us what investors *should* do in an idealized world. In order to evaluate actual investment behavior we can either examine the actual decisions that investors make or we can see how investors behave in a controlled setting with artificial problems. As Campbell [2006] points out in his American Finance Association Presidential address, there is surprisingly scant empirical evidence on what investors *actually* do in the real world.[2] Further, differences between the real world and the idealized baseline model make it challenging to evaluate actual decisions. Nevertheless, Campbell suggests that "some households make investment mistakes" (p. 1554) and that "if households make investment mistakes, it may be possible for financial economists to offer remedies that reduce the incidence and welfare costs of these mistakes" (p. 1555).

This section reviews three areas that have relevance for designing financial advice. It discusses the evidence that investors have limited computational ability. For the portfolio problem, this means difficulties aggregating risk across investments and across time. It discusses evidence that investors have limited attention, which implies that the form, placement and saliency of information about risks may affect judgments and decisions. Finally, it discusses the debate on how choice under risk is made; in particular, the debate between economic maximization models of choice and information processing models of choice. The decision processes used by investors can affect the types of information they actually use or find helpful.

LIMITED COMPUTATION ABILITY

In the baseline model, investors have unlimited computational ability and optimize their choices efficiently. In reality, computational ability is limited. Experimental research suggests that investors have trouble understanding some of the basic underlying principles of the baseline model.

Correlation and Diversification

In theory, investors must understand correlation and its impact on portfolio diversification and risk, to implement optimal portfolio selection (e.g., Markowitz [1952]) or achieve optimal risk/return tradeoffs (e.g., the Capital Asset Pricing Model, Sharpe [1964]). Both models imply that if investors invest in even a relatively small portfolio of investments, risk is determined primarily by correlations across investments. However, experimental evidence suggests that people neither understand the importance of correlation and diversification, nor do they behave as if they understand it. Investors who fail to understand this may hold too few assets and as a result face more risks than necessary in their portfolio.

In Kroll et al. [1988], experimental subjects seem to ignore correlation in building portfolios. They also do not follow the mutual fund separation theorem when a risk free asset is introduced. Lipe [1998] shows that subjects use variance, but not correlation, in determining investments.

2 Data on investor behavior is hard to obtain. Campbell reviews a variety of sources, including surveys, brokerage records and government records, and the drawbacks of each in section I.A. arguing that measurement of behavior is challenging.

However, knowledge, presentation and context may matter. Kroll and Levy [1992] find more support for traditional financial models when subjects (1) are MBA investments students, (2) publicly see the outcomes of all subjects' choices and (3) are threatened with loss possibilities. Kroll et al. [2003] show that subjects do better at attaining efficient portfolios when they are pre-specified and given to them (instead of having subjects mix existing assets into portfolios to achieve them). Lipe [1998] shows that subjects' risk judgments accord more with accounting measures of risk than market measures of risk. The former measure asset properties in isolation while the latter depend on correlations across assets.

Failure to consciously understand correlation and diversification may not harm investors if they behave as if they understand and diversify efficiently anyway. On the other hand, a lack of understanding will be costly if the result is suboptimal diversification. The latter seems to be the case. Using survey and field evidence, Benartzi and Thaler [2001] document that subjects seem to follow a"1/n" allocation rule where the number of funds available for investment affects the allocation of investments across classes. This can lead to sub-optimal allocation if multiple funds in an asset class bias investment toward that class and away from a well diversified portfolio. While Huberman and Jiang [2006] note that this effect weakens when there are more than 4 funds, Rieskamp [2006] confirms that investors tend to put more in stocks if there are more stock funds available. Statman [1987] summarizes evidence that investors are typically under-diversified. Using field data from Sweden, Calvet et al. [2007] also document under-diversification and the associated costs (though the costs of under-diversification are small relative to the costs of under-investing).

Overall, the evidence suggests that investors may have difficulty understanding how individual investments aggregate into portfolios. This will have welfare costs if it affects diversification. Thus, presenting investors with information about portfolios will facilitate better choices than presenting information about individual investments, which requires that the investor aggregate the information to determine portfolio risks.

Risk across Time

Many investors believe that stocks are a safer investment if held for a long period of time. This belief can stem from the expectation that stock prices will revert to the mean (if stock prices fall, they will rebound) or from the notion that there is time diversification (by holding stocks for a long period of time, risk is reduced). Financial theory, in particular, the standard multi-period version of the baseline model (Merton [1971]), generally does not support either belief (e.g., see Bodie [1995]). Without rehashing the arguments here, it is clear that mistaken beliefs about investing for the long-run can alter an investor's behavior.

A number of papers have used experiments to examine how subjects deal with risk over time. Samuelson [1963] provided a benchmark result by showing that an investor who will not take a gamble once should not take the gamble if it is repeated many times. One result suggesting that investors have difficulty aggregating risks over time is that subjects in a variety of experiments behave differently towards a repeated gamble when provided with single period return information as opposed to being given the distribution of the final return. Papers touching on this issue include Anderson and Settle [1996], Benartzi and Thaler [1999], and Klos et al. [2005]. The findings indicate that subjects are excessively influenced by information about short-run distributions. An implication of the studies is that investors should be given information about terminal distributions rather than be expected to aggregate information about short-run distributions across time.

Other studies examine the effects of short-term results on allocations. For example, Moore et al. [1999] find that investors overestimate performance, expect trends to continue, and respond to losses by reallocating assets away from the losing asset. This suggests that even in a controlled setting, investors are better served by focusing on long term results.

Implications

The evidence on limited computational ability implies that investors will have difficulty making optimal choices when information requires complex processing, such as aggregating risks across investments or time. The implication for investment advisors is that information should be processed and presented in a format that simplifies optimal choices. For example, individual investments could be aggregated into portfolios instead of presented separately. Horizon specific return projections could be made instead of presenting annual return information. An advisor could ask for the investor's preferences across efficient portfolio choices instead of expecting investors to build efficient portfolios by themselves. These observations suggest, for example, that appropriately designed and communicated lifetime funds may improve investor choices.

LIMITED ATTENTION

In the baseline model, investors can process enormous quantities of information. In reality, individuals have limited attention. Much experimental evidence shows that people make decisions based on heuristics, or short-cuts, instead of considering all available information. Further, people pay attention to some kinds of information more than others. This can have an impact on asset allocation decisions.

Several documented heuristics show how decision short cuts are influenced by how information is presented. Kahneman and Tversky [1973] document the "representativeness" heuristic. When asked to forecast future outcomes, experimental subjects tend to pick the outcomes that most closely resemble the main features of existing evidence. Tversky and Kahneman [1973] document the "availability" heuristic. When asked to assign likelihoods to particular events, subjects are heavily influenced by how easily specific examples come to mind. Such heuristics suggest that, in spite of all warnings to the contrary, investors do assume past performance indicates future performance. Furthermore, particularly easy to recall events (e.g., the great depression or the dot-com bubble) will have excessive influence in decisions.

With limited attention, not only what information is presented, but how it is presented may matter. Summarizing experimental research on decision processes in general, Kleinmuntz and Schkade [1993] state simply that "information displays influence decision processes by facilitating some decision strategies while hindering others" (p. 221). Libby et al. [2002] summarize many lines of experimental accounting research including research that shows subjects react not just to the substance of accounting reports, but also to their form. They conclude that "firms that are in identical economic circumstances except for their choice of accounting alternatives are sometimes judged to be different." Of particular importance is the "salience" (defined as the ability to attract attention) of different information formats (e.g., see Fiske and Taylor [1991]). Information that has high salience stands out from the rest. Hirshleifer and Teoh [2003] argue theoretically that the same information presented in a less salient manner (e.g., in the footnotes of a financial report instead of the body) can affect investor perceptions and asset prices. Hirshleifer et al. [2004] show that this can affect asset prices empirically.

Overall, the evidence on limited attention implies that both what the information is presented to investors and how it is presented may affect asset allocation decisions. The implication for investment advisors is that the most important, decision-relevant information needs to be up front and clearly presented in a salient manner.

EFFECTS OF CONTEXT

In the baseline model, investors acquire the appropriate information without bias and optimize the distribution of final wealth based upon that information. However, evidence suggests that the ways investors acquire and process information can be complicated. Further, investors may have a multi-dimensional view of risk and evaluate outcomes relative to fears, aspirations and other benchmarks such as the status quo. This can lead to behaviors not predicted by the baseline model and may lead to choices that harm lifetime financial security. Recognition of such factors can help financial advisors improve outcomes.

Psychologists have long argued that, contrary to the rational economic baseline model, investors should be viewed as information processors who are influenced directly by the form, order and attributes of information presented to them. Investors actually respond to a set of perceived attributes or "dimensions" of the risks they face when making choices.[3]

One dimension of risky choice arises from "framing effects," where the presentation context can alter the choices investors make. Citing experimental and anecdotal evidence, a variety of researchers in economics and psychology (e.g., Roy [1952], Kahneman and Tversky [1979], Lopes and Oden [1999], among others) argue that investors evaluate risk by comparing outcomes to specific reference points. Their attitudes about a specific outcome change depending on whether the outcome is above or below the reference point(s). For example, an investor may ask whether he or she has gained or lost money. In prospect theory (Kahneman and Tversky [1979]), the reference point is the current wealth level. Investors are risk averse in gains, risk seeking in losses and, in general, are more sensitive to losses than gains. Another common reference point is whether an investor has achieved pre-defined goals. Lopes and Oden [1999] add an aspiration level reference point. Such reference points would arise naturally in savings plans with specific goals (e.g., a subsistence level or an affluence target for retirement income). Whether specific asset allocations are likely to achieve or fall short of specific goals adds a non-standard dimension to the asset allocation problem.

Recent research using functional MRI scanning has explored the neurophysiological basis of decision-making. This may help researchers understand both the processes used in decision-making and how information and context affect decisions. For example, Kuhnen and Knutson [2005] find that distinct areas of the brain appear to be involved in decisions that entail risk-taking as opposed to decisions that involve risk avoidance. Remarkably, Kuhnen and Knutson [2010] find that stimulation of the brain structure associated with risk-taking (the nucleus accumbens), for example by showing erotic pictures to subjects, can increase the propensity to take risk. Kuhnen and Knutson [2010] show a link between lifetime wealth and debt accumulation and the speed with which subjects learn about profitable and unprofitable investments in a trial (which in turn was correlated with the neural imaging results in Kuhnen and Knutson [2005]). While research in this area is in its infancy, it nevertheless seems likely that findings from neural imaging will be important for understanding and possibly influencing major decisions such as the asset allocation decision.

All of this research suggests that to give the best financial advice, advisors need to understand the way investors think about decisions and the process through which decisions are made. Information presentation likely matters. In addition, the process that investors use to make choices may matter. Finally, the functional MRI data suggests that investors may arrive at different decisions if the asset allocation problem is framed as a risk taking or risk avoidance problem.

CAN UNDERSTANDING BEHAVIORAL FINANCE HELP IMPROVE CHOICES?

Several recent research lines suggest that (1) decisions may be more rational than some of the research above suggests, (2) even irrational decisions may not be as harmful as one might think, (3) behavioral factors can actually be employed to help improve choices and, finally, (4) information can be presented in ways that investors find more agreeable and useful.

Several studies suggest that small changes to the standard model can help individual decisions to be understood as more "rational," conforming more closely to the optimization model of choice. For example, recognizing that investors fear rare, but severe market crashes can help explain low equity allocations in the face of the high historical equity risk premium (Rietz [1988] and Barro [2006]). Recognizing that people sometimes make random errors can explain preference reversals (Berg et al. [2003] and Berg et al. [2010]). Utility functions of investors who evaluate returns relative to targets can take the form of Friedman and Savage [1948] utility functions and, thus, explain some otherwise anomalous behaviors such as buying insurance and playing the lottery simultaneously. This implies that effective advice needs to take into account the full range of investor preferences (i.e., to achieve a particular goal). It also needs to allow for investors who make errors.

3 See Payne [1973] for an early summary of this view.

Other studies suggest that sub-optimal behavior may not be particularly harmful in some situations. Cochrane [1989] shows that suboptimal consumption decisions in the standard model may not be very costly. Along similar lines, Calvet et al. [2007] examine Swedish household finance data and show that under-diversification, while prevalent, was not particularly costly to Swedish investors. This arises because of considerable international diversification inherent in popular mutual fund investments. These investments effectively protect the investors from their own "mistake" of under-diversification.[4] Analyzing trader behavior in small betting markets, Oliven and Rietz [2004] observe that many traders make many patently sub-optimal decisions. They often buy at prices higher than the best available price and sell at prices lower than the best available price. However, Oliven and Rietz [2004] also show that this behavior has limited impact. The market itself is both relatively efficient and deep. This means that, even if they are not the best available, trading prices are generally close to fair value. To the degree that financial markets are efficient, investments are priced fairly and investors are fairly rewarded for the risks they bear. Again, investors are largely protected from whatever "irrational" reasons they may have for the investments they choose.

Several research lines suggest that understanding and exploiting behavioral factors can improve choices. For example, behavioral factors may lead to the success or failure of specific attributes of financial plans. Shefrin and Statman [1993] provide a behavioral framework that they argue promotes success (or failure) of particular financial products.[5] Behavioral factors may also be used to help achieve specific financial goals. Using a behavioral basis, Benartzi and Thaler [2004] show that re-structuring work-place savings programs can increase savings. Bhandari et al. [2008] suggest that appropriate decision support systems can help remove biases from investor decisions. Nenkov et al. [2009] suggest that simply asking investors to consider all the possible outcomes of a decision can help avoid biases.

Finally, recent research also suggests that information can be packaged in ways that are more or less preferred by investors. For example, Anderson and Settle [1996] find that subjects have definite preferences over the kinds of information they receive about investments.[6]

SUMMARY

To make financial advice as effective as possible in helping investors with the asset allocation problem, the advice will need to recognize theoretically relevant information (e.g., average asset returns, variances and correlations). But it should also consider how investors use information in making decisions and how information can be best packaged to meet the needs, preferences and biases of investors. While experimental economics and behavioral finance provide some insights, much research remains to be done in this area.

4 On the other hand, failure to invest sufficient funds in the market was costly to many Swedish investors.

5 In particular, they argue that combinations of behavioral factors (Prospect Theory (Kahneman and Tversky [1979]), Hedonic Framing (Thaler [1985]) and Behavioral Life Cycle Theory (Shefrin and Thaler [1994])) make covered calls a particularly popular financial instruments.

6 Specifically, subjects are asked to project portfolio returns over a ten year horizon and are given information about either the one year or ten year return distributions of alternatives. Evaluating data across experiments (where other factors change as well), they conclude that subjects prefer to receive return information in the form of quantiles of the distributions, followed by moment summaries of the distributions, followed by densities.

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