

# *A Behavioral Approach to Asset Pricing*

Second Edition

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*To my mother Clara Shefrin and  
the memory of my late father Sam Shefrin.*



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# Preface to Second Edition

The opportunity to write a second edition of *A Behavioral Approach to Asset Pricing* enables me to reiterate a core message in the book. That message is: The future of asset pricing theory lies in bringing together the powerful SDF-based tools adopted by neoclassical asset pricing theorists and the more realistic assumptions adopted by behavioral asset pricing theorists. Put somewhat differently, I propose that neoclassical asset pricing theorists and behavioral asset pricing theorists converge to common middle ground. In this regard, I am grateful to Robert Shiller who, in endorsing the first edition of this book, stated the core message.

In the last part of the book, I point out that there has been progress in moving to common middle ground. In the main, most of this progress has come from neoclassical asset pricing theorists who have begun to adopt behavioral assumptions. As of the time I am writing this preface, behavioral asset pricing theorists have been much slower to adopt SDF-based techniques.

The second edition features the addition of new material. The most significant new material pertains to

- the extension of the log-SDF decomposition to incorporate behavioral preferences
- the connection between behavioral mean-variance portfolios and coskewness
- the sentiment of individual stocks
- the benefits of SP/A theory relative to prospect theory

- new evidence involving the disposition effect, and
- theoretical advances in developing behavioral asset pricing models in both discrete time and continuous time.

The new material covers many papers that were not part of the first edition. In this regard, I have been selective, focusing on papers that provide insights into the behavioral SDF-based approach to asset pricing. As I mentioned in the first edition, this book makes no attempt at providing comprehensive coverage of the literature. There are many interesting papers dealing with either behavioral issues or asset pricing issues that I have not included because they are not closely linked to the behavioral SDF approach. For example, I do not include papers dealing with such issues as style investing, dividends, or home bias, as interesting as these topics are.

The most important equation in the first edition of *A Behavioral Approach to Asset Pricing* is the decomposition of the log-SDF into sentiment and a fundamental component. In the second edition of the book, I have extended the analysis to demonstrate how this equation can be generalized to encompass the combination of behavioral preferences and behavioral beliefs. This generalization provides a unified approach that ties together the main ideas in the book more comprehensively than in the first edition.

In the second edition, I have made an effort to introduce the key concepts and relationships much earlier in the book. In particular, Chapters 4 and 9 of the second edition include short sections that prefigure the main results. They do so by providing simple illustrative examples of sentiment, the pricing kernel, and the log-SDF decomposition result.

Chapter 17 of the first edition describes behavioral mean-variance portfolios and behavioral risk premiums. Notably, behavioral mean-variance portfolios are more complex than weighted averages of the market portfolio and the risk-free security. Instead, behavioral mean-variance portfolios reflect the use of derivatives to exploit pockets of mispricing. This point is important. In 2006, the total outstanding amount of financial derivatives on world markets was estimated to be about \$480 trillion, and growing rapidly. As a result, there is reason to expect that activity in the derivatives market spill over and impact the risk premiums in equity and bond markets. Indeed as this book goes to press, global equity markets have declined sharply, reflecting trades in collateralized debt obligations (CDOs) and structured investment vehicles (SIVs).

The second edition extends the analysis of risk and return to identify conditions under which coskewness with the market portfolio is a key variable underlying risk premiums. This analysis has empirical implications. Chapter 23 of the second edition now includes a discussion of the empirical literature on coskewness, and why the evidence supports the behavioral theory developed in Chapter 17.

The first edition introduced the concept of a sentiment function and discussed empirical evidence about the projection of that function onto

the return distribution for the S&P 500. The second edition extends the discussion to the projection of the sentiment function onto the return distribution for individual stocks.

The first edition described theoretical implications for the portfolio choices of investors with prospect theory preferences. In doing so, I made the point that although prospect theory is quite rich in its descriptive power, it also possesses features that are highly unrealistic, and not supported by experimental evidence.

In the first edition, I developed the portfolio implications for investors whose preferences conform to SP/A theory, a psychologically based theory of choice developed by Lola Lopes that serves as an alternative to prospect theory. Meir Statman and I used SP/A theory as the basis for the framework we call “behavioral portfolio theory.” In the second edition, I describe contributions to the literature suggesting that in key ways, SP/A theory is superior to prospect theory. Moreover, SP/A theory naturally accommodates important new insights from the emerging field of neuroeconomics about the impact of brain structure and hormones on risk taking. For these reasons, I have augmented the discussion of SP/A theory in the second edition.

The disposition effect is the most well studied aspect of individual investor behavior in behavioral finance. In 1985, Meir Statman and I introduced the concept and coined the term. At the time, we suggested that the disposition effect reflects a series of psychological phenomena, one of which is prospect theory. At the same time, we cautioned that, by itself, prospect theory is incapable of explaining the effect. In the second edition, I review the basis for the disposition effect in greater detail than I did in the first edition. In this respect, I discuss new findings that shed light on the key role played by psychological phenomena other than prospect theory that Meir Statman and I proposed.

The first edition described the asset pricing implications associated with the disposition effect. Since the first edition appeared, several interesting papers have been published on this topic. The second edition includes a discussion of the recent literature on how the disposition effect impacts prices.

The first edition developed behavioral asset pricing theory using a discrete time framework, and included a limited discussion of continuous time models in connection with option pricing. Since the first edition was published, several important continuous time models have appeared in the literature. As a result, I have added a new chapter which surveys several of these models and links them to the core ideas in the book. In the main, these contributions focus on modeling heterogeneous beliefs instead of the representative investor assumption. This is a welcome development. A key point in this book is that the representative investor assumption tends to inject bias into asset pricing models. This message is important for asset pricing theorists, be they neoclassical or behavioral, who continue to invoke the representative investor assumption without regard to the associated biases.

Two of the major revisions discussed above resulted from conversations I had during a visit to Duke University. The conversations were with Campbell Harvey and John Payne, respectively, and I express my gratitude to both.

The conversation with Campbell Harvey occurred in connection with my having presented “On Kernels and Sentiment,” the paper upon which the book is based. After I presented the theoretical implications associated with behavioral mean-variance portfolios, based on Figure 15.4, Harvey suggested a link to his work with Akhtar Siddique on coskewness. Harvey and Siddique explained their findings in a neoclassical framework involving a quadratic SDF: They associated this SDF with a representative investor utility function featuring a positive third derivative, and hence a demand for positively skewed returns. In this second edition, I suggest that their findings instead reflect behavioral phenomena, rather than neoclassical phenomena.

The conversation with John Payne occurred in connection with findings in his work which run counter to the predictions of cumulative prospect theory. In this second edition, I suggest that for the purpose of modeling behavioral preferences, Payne’s findings support the use of SP/A theory over cumulative prospect theory.

The second edition of this book provides me with an opportunity to make corrections to the errors and omissions that I did not catch in the first edition. For their help in identifying errors in the first printing, I thank George Constantinides, Anke Gerber, Peter Nyberg, David Margolis, Huanghai Li, Vladimir Mlynarovic, Doruk Ilgaz, and Mei Wang. For their feedback on new material in the second edition, I thank Gurdip Bakshi, Sanjiv Das, Bernard Dumas, Elyès Jouini, Valerio Poti, Mark Seasholes, and Raman Uppal. I am especially grateful to Jens Jackwerth and Andrey Ukhov for kindly sharing data with me. I am very appreciative to *The Journal of Investment Management* and to *The Journal of Investment Consulting* for allowing me to include material, authored by me, from articles, both forthcoming and published, as part of this second edition. I would also like to express my appreciation to the Dean Witter Foundation for both their financial assistance and their longstanding support of Santa Clara University.

Special thanks to the Elsevier team for helping me put this second edition together. My editor, Karen Maloney, was incredibly supportive throughout the process. Jay Donahue, the project manager, was a joy to work with in terms of flexibility, communication, and efficiency. Greg deZarn-O’Hare smoothly facilitated file management.

Finally, I thank my wife Arna for her great patience during the time I was preparing this second edition.

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2008

# Preface to First Edition

In this book, I present a unified, systematic approach to asset pricing that incorporates the key concepts in behavioral finance. The approach represents the culmination of almost twenty years of thought about the impact of behavioral decision making on finance in general, and asset pricing in particular.

This work is neither a handbook, nor a comprehensive survey, nor a collection of previous writings. Rather, it is a treatise about how modern asset pricing theory, built around the concept of a stochastic discount factor (SDF), can be extended to incorporate behavioral elements. The book presents behavioral versions of the term structure of interest rates, option prices, mean-variance efficient portfolios, beta, and the SDF. This is not a collection of separate behavioral theories. Instead, they are all special cases of a single, unified, behaviorally based theory of asset pricing.

In order to develop the approach, I begin with what seems to me to be the most important behavioral concept for asset pricing. That concept is *representativeness*. The first several chapters introduce the concept, first from the perspective of psychologists, and then from the perspective of economists. Having introduced the concept, I then devote several chapters to explaining how representativeness affects the expectations and decisions of real investors, including academics.

I develop a sequence of models to explain the impact of representativeness on asset pricing. In an attempt to make the key features of the models as clear as possible, I have structured the first models very simply. I only add complexity on an as-needed basis.

Besides representativeness, there is a wide range of other behavioral concepts. Examples include overconfidence, prospect theory, excessive optimism, anchoring and adjustment, availability, self-attribution error, and conservatism. All of these concepts play roles in this book. Of these, overconfidence is the most important.

To my mind, the most important feature of the approach in this book is that it provides a theoretical structure to analyze the impact of behavioral beliefs and preferences on all asset prices through the SDF. In this respect, the approach in this book develops testable hypotheses about the shape of the SDF function. These hypotheses link the empirical evidence on investor expectations to the shape of the empirical SDF.

Unlike the downward sloping SDF found in traditional theory, a typical behavioral SDF oscillates. The theory developed in this book provides hypotheses for how the distribution of investor errors generates particular oscillations in the SDF. In other words, oscillations in the graph of the SDF are not arbitrary residual variables that, for lack of an alternative explanation, are attributed to investor sentiment. Rather, empirical evidence about investor errors is presented and, in conjunction with the theory, used to develop hypotheses about the oscillating patterns in the SDF. I argue that the empirical evidence about the shape of the SDF supports the hypotheses in question.

As the title of the book indicates, the body of work described therein is a behavioral approach to asset pricing. Indeed, it is not the only behavioral approach to asset pricing. Alternative approaches can be found in the pages of academic journals in finance, and in books in behavioral finance that address market efficiency. None of the alternative approaches focuses on the SDF. Instead they emphasize utility functions that exhibit constant absolute risk aversion and mean-variance principles.

In 1986 I began to develop general equilibrium models that accommodated behavioral assumptions, asking how behavioral phenomena affected the character of equilibrium prices. The core ideas in this book took shape in a paper I eventually entitled "On Kernels and Sentiment." Traditional theorists initially criticized the paper for being too behavioral, suggesting that I eliminate the focus on investor errors and concentrate on the implications of heterogeneous beliefs. Behaviorists initially suggested that the paper was insufficiently behavioral, proposing that I concentrate less on heterogeneous beliefs, and more on specific investor errors.

The contradictory criticisms of traditionalists and behaviorists reflect some of the reasons why members of both camps did not embrace the behavioral asset pricing approach that I was proposing. Traditional asset pricing theorists were reared in the tradition of rational expectations, and found the behavioral emphasis on investor error counterintuitive. Behaviorists were largely empirically focused, and not especially interested in a general asset pricing framework that was theoretically oriented rather than empirically oriented.



Interactions with critics have influenced the presentation of ideas in this book. The most common criticism from traditional asset pricing theorists is that the main theoretical results in the book are false. I learned a great deal from these interactions. For example, Richard Green suggested that I develop a behavioral binomial option pricing example to illustrate my contention that heterogeneous beliefs can give rise to smile effects in the implied volatility function for options. In doing so, I gained a deeper understanding of the model's structure, and the example can be found in Chapter 21. Kenneth Singleton, a leading asset pricing theorist, indicated that he was better able to follow a critic's argument that one of the theorems was false than the proof of the theorem. Singleton's remark led me to improve the exposition of the proof.

To my mind, the most important feature of the approach in this book is that it provides a theoretical structure to analyze the impact of behavioral beliefs and preferences on all asset prices through the SDF. Not everyone agrees. Kenneth Singleton took the position that I should be focusing on option prices, not the shape of the SDF. He also asserted that it is sufficient to assume heterogeneous risk tolerance, not heterogeneous beliefs. Although I discuss these points in the book (Chapters 16, 21), at this point let me speculate that theorists who have been reared in the tradition of rational expectations might find the idea of investor errors, meaning nonrational expectations, counterintuitive. Therefore, many avoid assuming heterogeneous beliefs in order to avoid assumptions involving investor error.

A common claim by traditional asset pricing theorists has been that the results in "On Kernels and Sentiment," which appear in this book, must be false. One critic claimed that the option pricing results in the paper violate put-call parity and therefore cannot hold. A second contended that a key bond pricing equation must be false. A third held that the main representative investor theorem would be remarkable if true, but in fact is false.

The counterarguments advanced by critics are sophisticated and interesting. The common nature of the criticisms suggests to me that they represent typical reactions by traditional asset pricing theorists. Because I suspect that the results presented here are highly counterintuitive to theorists reared in the tradition of rational expectations, I have included their major criticisms in the book. Doing so provides me with an opportunity to explain why the criticisms are incorrect. Not doing so would increase the risk that traditional asset pricing theorists will continue to believe that my results are false.

My hope is that with the publication of this book, asset pricing theorists will accept that my results are correct, and attention will shift to the application of behavioral asset pricing theory. Future work should investigate whether observed oscillations in the empirical SDF stem from investor errors, from rational sources, or from both. In this respect,

observed oscillations in the empirical SDF are not tautologically attributed to sentiment. Rather, the theory developed in this book generates testable predictions that link the distribution of investor errors to the shape of the SDF. Different error distributions give rise to different shapes of SDF. These linkages can be used to structure new tests based on new data sets or new time periods. Behavioral asset pricing predicts that when the error distribution is time varying, so too will be the SDF. And the empirical evidence presented in this book indicates that the error distribution is indeed time varying.

In recent years, research has documented that the graph of the empirical SDF features an oscillating pattern. “On Kernels and Sentiment” dates back to 1996, and to the best of my knowledge, predates empirical work reporting that the SDF features an oscillating pattern. The early versions of the paper predicted that the SDF would feature an oscillating pattern that I called a “kernel smile.” The point is important, in that I did not set out to produce a model whose results fit the data. As far as I can tell, my paper was the first to suggest that the SDF featured an upward sloping portion. Indeed, no reader of the early versions of the paper appeared to find the claim of much interest.

The core material in this book has not appeared in print before. In addition to the core, I have selected a body of work, some published, some unpublished, that illuminates how the core ideas apply to asset pricing in the real world. The literature that I have chosen to include relates directly to the core ideas. My purpose in selecting these works is to provide support for the core approach, and to indicate how the core ideas relate to the existing literature. In this regard, I make no effort to be comprehensive or inclusive. There are many fine works that I have chosen not to mention, simply because I did not judge their inclusion as fitting my agenda.

My apologies to readers for duplicate notation in a few places, or in order to avoid duplicate notation, unusual notation in others. Notation is consistent within chapters, but in a few instances is not consistent across chapters. For example,  $\alpha$  is used for regression coefficients in Chapter 3, but as an exponential smoothing parameter in Chapter 18. Having used  $P$  and  $p$  to denote probability, I used  $q$  to denote price, even though  $p$  or  $P$  is more common for price.

I would like to express my gratitude to many people who provided advice and comments during the development of this work. Scott Bentley and Karen Maloney, my editors at Elsevier, provided much guidance and encouragement. I would also like to thank Elsevier staff members for their help, especially Dennis McGonagle, Troy Lilly, and Angela Dooley. Conversations with Maureen O’Hara and John Campbell persuaded me that there were too many integrated ideas in “On Kernels and Sentiment” for a single paper, and that a book might be the appropriate way to provide a unified treatment of the approach. Three reviewers provided invaluable comments

and suggestions, for which I am very appreciative indeed. Wayne Ferson was kind enough to invite me to present “On Kernels and Sentiment” to his graduate asset pricing class, and to offer a series of constructive suggestions. Bing Han read through an early version of the manuscript and provided many helpful comments. Jens Jackwerth and Joshua Rosenberg read excerpts from the book, and made important comments. Ivo Welch was kind enough to share the data from his surveys of financial economists with me. My colleague Sanjiv Das, himself working on a book, shared all kinds of useful tips with me. My colleague and good friend Meir Statman engaged me in countless stimulating and productive conversations on many of the topics discussed in the book. Robert Shiller kindly provided me with one of his figures. Seminar participants at the University of Michigan, Duke University, Stanford University, Queens University, the Chicago Board of Trade, Tel Aviv University, the Interdisciplinary Center (IDC), and the Hebrew University of Jerusalem made excellent suggestions. I especially thank Alon Brav, Roni Michaely, Oded Sarig, Simon Benninga, Jacob Boudoukh, Eugene Kandel, Zvi Weiner, Itzhak Venezia, David Hirshleifer, Bhaskaran Swaminathan, Terry Odean, Ming Huang, Peter Carr, Joseph Langsam, Peter Cotton, Dilip Madan, Frank Milne, and Campbell Harvey. John Ronstadt from UBS was kind enough to help me locate data from the UBS/Gallup Survey. I am also grateful to those who have been critical of this work, whose challenges helped me achieve a deeper understanding of the ideas than would otherwise have occurred. Needless to say, none of the individuals mentioned above is responsible for any errors that remain in the book. I thank the Dean Witter Foundation for financial support. Finally, I thank my wife Arna for her strong, unwavering support during the long gestation period of this work.

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Hersh Shefrin holds the Mario L. Belotti Chair in the Department of Finance at Santa Clara University's Leavey School of Business. He is a pioneer of behavioral finance, and has worked on behavioral issues for over thirty years. *A Behavioral Approach to Asset Pricing* is the first behavioral treatment of the pricing kernel. His book *Behavioral Corporate Finance* is the first textbook dedicated to the application of behavioral concepts to corporate finance. His book *Beyond Greed and Fear* was the first comprehensive treatment of the field of behavioral finance. A 2003 article appearing in *The American Economic Review* included him among the top fifteen theorists to have influenced empirical work in microeconomics. One of his articles is among the all time top ten papers to be downloaded from SSRN. He holds a Ph.D. from the London School of Economics, and an honorary doctorate from the University of Oulu in Finland.