Behavioral Finance: an introduction

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OUTLINE

This survey introduces and reviews the field of behavioral finance. It outlines the traditional finance approach, which builds upon rational acting investors, its assumptions, and its shortcomings. Moreover, it surveys the main findings from psychology and sociology that contrast with this traditional finance approach, and it provides examples of situations and studies that reveal the relevance of these findings for financial markets and its participants.

Key words: behavioral finance, investor psychology, investor behavior, financial markets, market efficiency, individual decision making.

JEL: A12, G00, G10, G11, G12, G14.

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1.1 Introduction

Over the past decade, behavioral finance has become a household name in the finance industry. Nowadays, many financial institutions offer financial services based on findings grounded in behavioral finance. For instance, defined contribution pension plans, in which participants have to decide how to invest their retirement money, use findings from behavioral finance to help participants improve their investment strategies. Also, many asset managers and hedge funds act based on strategies originating in behavioral finance.

As the name suggest, behavioral finance aims at improving the understanding of financial markets and its participants by applying insights from behavioral sciences (e.g. psychology and sociology). This in sharp contrast to the traditional finance paradigm, which seeks to understand financial decisions by assuming that markets and many of its participating people and institutions (called economic agents) are rational. That is, they should act in an unbiased fashion and make decisions by maximizing their self-interests. In essence, the economic concept of rationality means that economic agents make the best choices possible for themselves.

Although appealing, this concept entails strong and unrealistic assumptions about human behavior and the functioning of financial markets. For example, it assumes that economic agents process new information correctly and make decisions that are normatively acceptable (Barberis and Thaler, 2003). Agents must be capable of integrating and considering many different pieces of information and must fully understand the future consequences of all their actions. Moreover, financial markets must be frictionless, such that security prices reflect their fundamental value (i.e. prices are right), and the influence of irrational market participants is corrected by rational traders (i.e. markets succumb to efficiency).

By contrast, human beings (like you and me) and financial markets do not posses all of these capabilities and characteristics. For example, people fail to update beliefs correctly (Tversky and Kahneman, 1974) and have preferences that differ from rational agents (Kahneman and Tversky, 1979). People have limitations on their capacity to process information, and have bounds on capabilities to solve complex problems (Simon, 1957). Moreover, people have limitations in their attention capabilities (Kahneman, 1973), and care about social considerations (e.g. by deciding not to invest in tobacco companies). In addition, rational traders are bounded in their possibilities such that markets will not always correct 'non-rational' behavior (Barberis and Thaler, 2003).

Therefore, classic finance theories may give a bad description of financial behavior. In fact, several studies confirm this suggestion in the aggregate behavior of financial markets, the trading behavior of individual investors and the behavior of managers.[1] For example, numerous evidence shows that the most important traditional asset pricing theory, the Capital Asset Pricing Model (CAPM), is inconsistent with many empirical regularities found in cross-sectional asset pricing data, showing that one group of stocks earn higher (risk-adjusted) returns than another.[2] Moreover, stock and bond returns are predictable based on various macro economic variables, as well as investor's sentiment measures (Fama and French, 1988, 1989, Whitelaw, 1994, Cremers, 2002, Avramov, 2004, Baker and

[1] For excellent reviews of the main fields of finance, Asset Pricing, Corporate Finance and Household Finance, and the role of Behavioral Finance in them, see Campbell (2000), Hirshleifer (2001), Barberis and Thaler (2003), Baker, Ruback and Wurgler (2006), and Campbell (2006).

[2] To name the best known examples; stocks with a small market capitalization earn higher (risk-adjusted) returns than bigger stocks (known as the "size effect", Banz, 1981). Similarly, stocks with a higher measure of fundamental value relative to market value earn higher returns than stocks with a low measure (known as the "value effect", Fama and French 1992, 1993). In addition, stocks they have performed well over the past year earn higher returns than stocks that have performed poorly (Jegadeesh and Titman, 1993). However, this "momentum effect" reverses itself over longer horizons. Stocks that have performed badly during the past three to five years outperform stocks that performed well (called the "long term reversal effect", De Bondt and Thaler, 1985, 1987). Furthermore, stocks with surprisingly good earnings outperform stocks with surprisingly bad earnings during the next 60 days (called the "post-earnings announcement drift", Bernard and Thomas, 1989 and Kothari, 2001).

Wurgler, 2007). Hence, not all information is correctly included in market prices. Another traditional finance anomaly is the equity premium puzzle, which says that stocks outperform bonds over long horizons by a difference that is too large to explain by any rational asset pricing theory (Mehra and Prescott, 1985). Furthermore, many individual investors hold investment portfolios that are insufficiently diversified or non-preferred (Benartzi, 2001 and Benartzi and Thaler, 2002) and that under-perform benchmarks due to excessive trading (Barber and Odean, 2000).

By contrast, the main thought behind behavioral finance is that investment behavior exists, that differs from what the traditional finance paradigm assumes, and that this behavior influences financial markets. Indeed, a number of recent studies show that behavioral finance theories are able to explain several empirical findings the traditional finance theories leaves unexplained. For example, Benartzi and Thaler (1995) and Barberis, Huang and Santos (2001) show how a disproportionally large aversion to losses, in combination with an annual investment horizon, can explain the puzzling high returns of equities over bonds (i.e. the equity premium puzzle). Similarly, Barberis, Shleifer and Vishny (1998), Daniel, Hirshleifer and Subrahmanyam (1998), Hong and Stein (1999) and Barberis and Shleifer (2003) explain the high (low) returns of stock after good (bad) earnings announcements, high (low) returns for recent winner (loser) stocks, and the reversal of these recent winner or loser returns over longer horizons, by modeling various behavioral biases and limitations to which investors are subject. Moreover, Shefrin and Statman (1984) show how behavioral finance can explain why firms pay dividends, while dividends actually have a tax disadvantage. Over and above, findings from behavioral finance have proven to be excellent tools for improving the decisions of individual investors, especially in investment decisions for retirement (see Benartzi and Thaler, 2004).

In the remainder of this paper I will discuss the field of behavioral finance in more detail. I start with discussing the main building blocks of the traditional finance paradigm (Section 1.2). Subsequently, I will turn to the

mainly psychological and sociological evidence that challenges part of these assumptions, and discuss the effects on the behavior of financial markets and its participants (Section 1.3). Finally, the last section (Section 1.4) concludes.

1.2 The traditional finance paradigm

In its attempt to model and study financial markets, the traditional finance paradigm starts from a few implicit normative assumptions about individual behavior that an economic agent should posses. In the remainder I will refer to this agent as the 'homo-economicus'. First, the 'homo-economicus' optimizes over all possible alternatives, it fully understands all consequences, and it only considers these consequences. For example, when the 'homo-economicus' is considering a choice between various investment alternatives, it considers all relevant assets and estimates their joint return distribution from all individual distributions. In essence, the decision maker as envisioned in the traditional finance paradigm is unbounded in its cognitive capabilities and abilities, It is a super mind. It can handle large demands on its capacity to process information and solve these complex problems, and it has extremely high computational capabilities (Simon, 1955).

Second, the 'homo-economicus' forms expectations that are in accordance with the laws of probability and it updates its beliefs correctly if new information arises. For instance, after tossing a fair coin 20 times and observing all heads, it still will assign an equal weight to heads as tails and act to that. And, when estimating the probability of a global depression it will consider all relevant information, and uses Bayes' law to update its estimate after observing a big bank failure.

Third, the 'homo-economicus' only values money or consumption, and makes decisions by maximizing its self-interest. The value it attaches to monetary outcomes or consumption is not influenced by aspects like mood,

experience with a specific scenario, sudden increases in fear or regret, and the feeling of others.

Fourth, the 'homo-economicus' either does not care about risk (i.e. it is risk neutral), or dislikes risk (i.e. it is risk averse), for every amount of wealth it could have. Hence, it is either risk neutral or risk averse in all situations and over all stakes, ranging from local lotteries to retirement portfolios, and from cents to thousands of dollars.

The traditional finance paradigm captures these assumptions by supposing that the 'homo-economicus' makes decisions in accordance with Expected Utility theory (EU) of Von Neumann and Morgenstern (1944) if the objective probabilities are known, and Subjective Expected Utility theory (SEU) of Savage (1954) if true probabilities are unknown but are estimated subjectively. These two theories are the rational preference theories for decisions under risk (EU) and uncertainty (SEU). In these theories, decisions are described as choices between alternatives that either have certain outcomes, or multiple possible outcomes of which the realization is not fully known in advance (called gambles or lotteries). These alternatives are characterized by a range of possible outcomes, to which values are assigned (called utilities or values) and judgment about the probabilities on these outcomes (called decision weights). For example, a choice between investing $1,000 in a one-year risk free bond yielding 5% or purchasing a stock fund and holding it for one year, can be represented as a choice between $1,050 for sure in one year, or say a 0.50 probability on $2,000 in one year and a 0.50 probability on $500 in one year.

The EU and SEU preferences are represented by the expectation of the utilities of all possible outcomes, where the expectation is taken over decision weights that equal the objective true probabilities (if they are known) or subjectively estimated probabilities (if the true probabilities are unknown). That is, the 'homo-economicus' behaves as if it maximizes

(1.1) $$U(X) = E\sum_{i=1}^{n} p(x_i)u(x_i)$$

where $u(x_i)$ is the expected utility of outcome x_i , $p(x_i)$ is the probability on that outcome, and the expectation is take over all n possible outcome. The assumption of risk aversion (risk neutrality) over the whole range of wealth is imposed by assuming that $u(x_i)$ is concave (linear) in x_i. For instance, in the choice situation outlined above the 'homo-economicus' behaves as if he trades off $U(RiskFreeBond) = u(1{,}050)$ with $U(StockFund) = 0.50 * u(2{,}000) + 0.50 * u(500)$ and chooses the alternative with the highest utility.

In addition, a fifth commonly applied assumption is that the 'homo-economicus' consistently and correctly discounts future payoffs; it values future payoffs by discounting them at a constant rate. Hence, the 'homo-economicus' behaves as if it maximizes

(1.2) $$U_t = \sum_{s=t}^{\infty} \beta^{s-t} U(X_s)$$

where $U(X_s)$ is the expected utility at time s, and β is a constant discount factor (see Stracca, 2004). In the previous example, the 'homo-economicus' who has a discount factor of say 5% (hence who cares moderately about the near versus distant future), will discount all utilities with this discount factor, and chooses the alternative with the highest present value. If there would be a third option that would payoff \$1,750 for sure in ten years (say a long-term bond) its utility would be $U(LongTermBond) = (1 * \$1{,}750)/(1.05^{10})$.

To recap, the implications of these normative assumption are as follows; the 'homo-economicus' behaves as a rational (S)EU optimizer, cares only about consumption or money, and uses the laws of probability to form

beliefs. It can handle large demands on its capacity to process information and solve complex problems, it has extremely high computational capabilities (i.e. it is a super mind), it is unbounded in its attention capacity and time, it is consistent in its time-discounting, and hence it knows its preferences and how it should decide and act.

1.3 Behavioral finance

Now I will turn to psychological and sociological evidence describing how actual humans differ from the 'homo-economicus'. I start with presenting evidence on how people make decisions, especially when they are complex (Section 1.3.1), followed by the systematic errors people make in forming their judgments and beliefs (Section 1.3.2). Next, I will discuss how people trade-off risk in their decisions given these beliefs, how their utilities depend not only on monetary outcomes or consumption, and how their time-discounting is not in line with that of the 'homo-economicus' (Section 1.3.3). Subsequently, I will explain why and when limits to arbitrage can cause these various behavioral patterns to influence outcomes in financial markets (Section 1.3.4).

1.3.1 How people handle decisions

Most financial decisions are made in situations characterized by a high degree of uncertainty and complexity. Often we have to choose between many alternatives, with many possible uncertain outcomes and probabilities, while many other (previous) decisions situations need to be considered as well. In such situations the 'homo-economicus' acts if it performs exhaustive searches over all relevant alternatives, evaluates all consequences by integrating the current decision with other decisions, and then picks the best alternative possible.

However, psychological work suggests that people are not able to behave in such a way in many situations. People are limited in their abilities and capabilities to solve especially complex problems (Simon, 1955, 1957, 1959, 1979, Arthur, 1994, and Conlisk, 1996). People are limited in their capacity for processing information, since we possess a limited working memory and limited computational capabilities. Moreover, people are limited in their attention capacity and hence ability to perform multiple tasks simultaneously (Kahneman, 1973). For example, a famous psychological finding is the "magical number seven plus or minus two" rule. It states that we can process only seven (plus or minus two) pieces or chunks of information at the same time (Miller, 1956). Therefore, the cognitive load required for complex decision problems often exceeds people's cognitive capabilities.

To overcome these problems and manage the problem of interest, people generally rely on a limited number of simplifying rules-of-thumb, or heuristics, which often fail to accommodate the full logic of decisions (Simon, 1955, 1979, Newell and Simon, 1972, Tversky and Kahneman, 1974, Gabaix and Laibson, 2000). For example, when people have to choose among many alternatives, they do not weight of the advantages and disadvantages of all choice options, but they choose among alternatives by sequentially eliminating alternatives that do not posses certain characteristics (Tversky, 1972, Payne, 1976).

A similar heuristic manifests itself in one of the most important financial decisions: the construction of people's investment portfolios. For most individual investors capital market investments form a major part of people's current and future wealth. However, constructing an investment portfolio is also one of the most complex financial problems, requiring a lot of cognitive load. It requires people not only to focus on the individual assets, but also on the interaction and statistical association between them. Baltussen and Post (2007) find that investors cannot perform this task in accordance with economic theory and instead adopt simplifying heuristics in practice. Investors tend to focus on the marginal distributions

of assets, while largely ignoring the influence of individual assets on their total portfolio. Subsequently, people tend to divide available funds equally between the alternatives that are selected by their attractiveness in isolation. This practice can lead to inefficient or non-preferred investment portfolios (and thereby to non-optimal financial positions), since it ignores diversification benefits.[3] Similarly, investors investing for retirement often use a conditional 1/*n* diversification heuristic (Benartzi and Thaler, 2001, and Huberman and Jiang, 2006). When the number of funds offered (*n*) is relatively small, plan participants tend to employ a naïve diversification strategy of investing an equal fraction (1/*n*) in all funds offered in the plan. Thus, the number of funds chosen increases as the number of funds offered increases and the fraction invested in equity increases as the fraction of equity funds offered increases. Further, when the number of funds offered becomes larger, participants tend to apply the 1/n rule to a subset of the funds offered. Again, this behavior can be suboptimal, because the precise framing of the investment decision does not alter the investor's optimal asset allocation.

Moreover, people organize, evaluate and keep track of decisions in ways that differ from that of the 'homo-economicus'. In this process, called "mental accounting" (see Thaler, 1980, 1999 for a more extensive overview), people tend to formulate and integrate decisions in a narrow fashion. They consider decision situations one at a time instead of adopting a broader frame (see also Tversky and Kahneman, 1981, and Kahneman and Lovallo, 1993). For example, many people consider buying stocks in the company they work for as separate from their human capital decisions, and ignore the influence that each decision has on the other.

In fact, the extent to which decisions are mentally or physically bracketed, or grouped together, substantially influences decisions (see Read, Loewenstein and Rabin, 1999). A set of decisions are bracketed together when they are made by taking the effect of each decision on all other

[3] In fact, Kroll, Levy and Rapoport (1988) and Kroll and Levy (1992) also find that investors' choices are largely insensitive to correlations between investment alternatives.

decisions within the same bracket into account, while ignoring the effect on other decisions. For instance, investors tend to care about fluctuations in the individual stocks they hold instead of fluctuations in their portfolios. This practice sometimes yields suboptimal or non-preferred portfolios, portfolios they would not choose if they choose over the return distribution of their total portfolios (Baltussen and Post, 2007). This form of "narrow bracketing" (or "narrow framing") can also have substantial effect on financial markets. For example, Barberis and Huang (2001) show that it yields historically high returns on stocks with favorable multiples of fundamental over market value, also known as the 'value effect' (see Fama and French, 1992,1993).

The way in which people bracket (or frame), depends heavily on how decision problems are presented. People are subject to cognitive inertia, meaning that people deal with problems they way they are presented. People tend to use only information that is displayed explicitly and use it the way it is displayed (Slovic, 1972). Moreover, if choices come one at a time, people bracket them narrowly, and if choices come many at a time, people bracket them more broadly (Redelmeier and Tversky, 1992, Read, Loewenstein and Rabin, 1999, Kahneman, 2003). For example, when choosing among several items, people tend to choose more variety when their decisions are presented simultaneously, than when choosing sequentially.

Mental accounting and narrow bracketing imply that the frequency with which people evaluate accounts has a large influence on decisions. In general, people are myopic. We evaluate decisions relatively frequently, and by that, make choices that we would not make if we evaluated over appropriately longer horizons (Thaler, 1999). This myopia is absent in the 'homo-economicus', since it considers the consequences of its decisions over its entire lifetime. An important financial illustration of this behavior is given by Thaler, Tversky, Kahneman and Schwartz (1997) and Benartzi and Thaler (1999). They show that investors invest more in stocks if a longer evaluation frequency is enforced, something they label "myopic loss

aversion".[4] In their examples, people made investment decisions between alternatives representing stocks and bonds with feedback and investment frequencies ranging between eight times a year till once every five years, or with histograms displaying the distribution of annual or 30-year rates of return. They found that people with longer evaluation frequencies invested a substantially larger part of their assets in stocks relative to bonds. This behavioral pattern appears to be especially strong among options and futures traders (Haigh and List, 2005). In a similar spirit, Langer and Weber (2001) show the opposite effect of evaluation frequency for loan like securities that consist of a small probability of a large loss. People are less willing to invest in these securities if they evaluate more frequently. In fact, this myopia helps to explain the historically puzzling high returns on equities over bonds (the equity premium puzzle), something that proves hard to explain using the behavior of the 'homo-economicus'. It appears that this traditional finance puzzle can be explained by investors having a relatively short (but plausible) investment horizon of one year, in combination with risk preferences that differ from that of the 'homo-economicus' (Benartzi and Thaler, 1995).

myopic loss aversion

In addition, people set up separate mental accounts, or mental budgets for different decisions and outcomes (Thaler, 1985). For instance, some money is kept as 'household money', some money as 'leisure money', some money as 'vacation money', and some money as 'investment money'. Between the various mental budgets, money is generally non-fungible. This practice helps us to overcome the self-control problems that we frequently encounter (Thaler 1999, Thaler and Shefrin, 1981). However, this mental processing is in sharp contrast with the rational view in economics that people should maintain a comprehensive view of outcomes and money is fungible. This leads to, for example, people paying high interest rates on credit card debt (used for leisure activities), while simultaneously having substantial amounts of money in lower yielding saving accounts (used for retirement purposes).

[4] Gneezy and Potters (1997) provide similar evidence in favor of myopic loss aversion.

To recap, our time and cognitive resources are limited implying that we cannot optimally analyze all information needed for fully rational decisions. Unlike the 'homo-economicus' we are often not able to solve complex problems and rely on heuristics instead. Moreover, we use mental accounting practices, where we consider decision problems one at a time, bracket decisions narrowly, evaluate decisions too frequently, and use different mental accounts for different decisions. In many situations, these heuristics and practices yield optimal behavior, but in some situations they do not, yielding consequential biases in financial markets. For example, they may cause higher returns on stocks with higher measures of fundamental over market value, and they cause different amounts invested in equities or fixed income instruments depending on the frequency or horizon with which we evaluate outcomes and decisions.

1.3.2 Psychological foundations for beliefs and judgments

One of the most important inputs for financial decisions are the expectations people have and how we form them. Traditionally, the field of finance assumes that the 'homo-economicus' forms its expectations according to the laws of probability and updates its beliefs correctly if new information arises. However, for many situations a wealth of evidence from cognitive and affective psychology indicates otherwise (for an extensive overview, see Rabin, 1998, and Kahneman, 2003). Most notably, often people reduce the complex task of forming expectations and assessing probabilities to simpler judgmental operations (Tversky and Kahneman, 1974). These judgmental heuristics are often very useful, but sometimes result in systematic errors (called "biases" or "cognitive illusions").

To start, when people evaluate the probability of an uncertain event (e.g. a good reputation of a specific company) belonging to a particular population (e.g. firms with good performing stock), they often make probability judgments using similarity, or what Kahneman and Tversky (1972, 1973)

call the "representativeness heuristic". According to this judgmental heuristic, people evaluate the probability of an uncertain event by the degree to which it is similar in essential characteristics to its parent population and reflects the salient features of the process by which it is generated (Kahneman and Tversky, 1972). When an event (a good reputation of a specific company) is highly representative of a class of events (a good performing stock), the belief that people assign to the event originating from that particular class is higher.

Representativeness induces several important biases in our expectations. It induces people to give too much weight to recent evidence and too little weight to base rates or prior probabilities (the so-called "base-rate neglect", Kahneman and Tversky, 1972), to make forecasts that are too extreme (Kahneman and Tversky, 1973), to underestimate the impact of new evidence that is not representative of a process (called "conservatism"), to judge a joint probability more likely as one of its components (called the "conjunction fallacy", Tversky and Kahneman, 1983), to neglect the information contained in the size of a sample, and to display misconceptions of chance. The latter means that people expect a string of realizations of a completely random process to represent the essential characteristics of that process, even when the sequence is short. As a result, people's beliefs are subject to the "gambler's fallacy", in which chance is viewed as a self-correcting process. For example, people believe that after four fair coin tosses in a row yielding heads tails is now due, since this will be more representative of a fair coin than five heads in a row.

In cases in which people do not know the underlying data generating process people often try to infer it from just a few data points. In fact, people generally believe small samples to be highly representative of the population from which they are drawn (called the "law of small numbers"), and tend to systematically overvalue this small sample evidence. For instance, people may think that even a two-year record is plenty of evidence for the investment skill of a fund manager. And, people may

believe that a stock market analyst is good after four successful predictions in a row, since this is not representative of a bad analyst (Rabin, 1998, Barberis and Thaler, 2003). Another implication of representativeness is that people try to spot trends in random processes (e.g. in stock prices) and expect past price changes to continue, (called the "extrapolation bias", see De Bondt, 1993 and 1998).

In a financial context Barberis, Shleifer and Vishny (1998) find an important consequence of representativeness. More precisely, they show that the representativeness biases creates the higher (lower) returns on stocks after they displayed good (bad) earnings announcements, the higher (lower) returns for recent winners (losers), and the reversal of these recent winner (loser) returns over longer horizons, as is commonly observed in financial markets. Moreover, Benartzi (2001) shows that representativeness helps in explaining why investors invest a substantial part of their retirement portfolios in the company they work for. In fact, Benartzi reports that about a third of the assets, and about a quarter of the discretionary contributions, in retirement savings plans are invested in company stock. From a diversification perspective, this clearly is a bad strategy. However, Benartzi finds that employees excessively extrapolate the past performance of their company's stock (and are overconfident about it), making this stock seem more attractive and less risky than it actually is, thereby resulting in high allocations to this stock.

Besides judging probabilities using similarity, people judge the probability of an event with the ease with which instances come to mind. This heuristic, called "availability", is generally employed when people have to judge the plausibility of a particular development (Tversky and Kahneman, 1974). Violations of the laws of probability arise, because not all events are equally retrievable. Availability is higher for recent events, events that are better imaginable, events that are easier to remember, events that are more vivid, events that are more familiar, and events that are more salient (Kahneman, 2003). For example, in a financial context people tend to give too much weight to recent information, and may assign

a higher probability to a bad stock market performance if they recently experienced a large stock market decline.

When people have to make numerical predictions, they often employ the so-called "anchoring and adjustment heuristic" (Tversky and Kahneman, 1974). People make judgments by starting form an initial value (the anchor) that is subsequently adjusted to yield the final judgment. However, in many cases this adjustment is insufficient, causing biases in beliefs. For example, when there has recently been a movement in the price of a stock that corrected a mispricing, investors may still anchor on this past price trend and expect it to continue (albeit in a weaker form).

Besides these heuristics, there exist other factors which bias people's expectations. People are generally overconfident (see Lichtenstein, Fischhoff and Phillips, 1982). This manifests itself as, among others, people thinking they can predict the future better than they actually can, people overestimating the reliability of their knowledge, people believing they have better abilities than others, people being excessively optimistic about the future, and people believing they can control the outcomes of completely random events (called the "illusion of control", Langer, 1975). Moreover, as argued by Barberis and Thaler (2003), overconfidence is often strengthened by the tendency of people; (i) to ascribe success to their own skills while blaming failure on bad luck (called the "self-attribution bias"), and (ii) to believe they predicted an event beforehand, but after it actually happened (called the "hindsight bias"). Similarly, most people have unrealistic views of their abilities and tend to engage in wishful thinking (Weinstein, 1980).

De Bondt (1998) nicely illustrates the relevance of overconfidence in a financial context. He finds that a group of individual investors investing between $25,000 and $1,025,000 in stocks are overconfident and optimistic about the future performance of the stocks they own, while simultaneously underestimating their risks. Moreover, Odean (1999) and Barber and Odean (2000, 2002) show how overconfidence by individual investors

results in excessive trading, and Goetzmann and Kumar (2008) find that overconfidence results in investors holding under-diversified portfolios. In addition, Daniel, Hirshleifer and Subrahmanyam (1998) show how overconfidence about the precision of private information (strengthened by a self-attribution bias) affects financial market prices, yielding similar patterns in asset prices as predicted by Barberis, Shleifer and Vishny (1998).

Another well-known psychological finding is that people are perseverant, or 'sticky', in their beliefs. They toughly and slowly change their opinions once they have formed them (Lord, Ross and Lepper, 1979). For example, once people become convinced that a particular stock is going to perform well, they underweight evidence that suggest that stock is actually a bad investment.[5]

In addition, people tend to bias their beliefs towards an equal chance on every possible partition (Fox and Clemen, 2005). For example, when people are asked to assess the probabilities that the price of next year's stock market falls in the 0-8,000, 8,000-12,000, 12,000-16,000 or 16,000+ range, the belief in a price exceeding 12,000 tend to be higher than when they are given the following partition: 0-4,000-, 4,000-8,000, 8,000-12,000 or 12,000+. Therefore, expectations depend on the partition of the outcome space, as is also observed in the former economic derivatives markets of Goldman Sachs and Deutsche Bank (see Sonnemann, Camerer, Langer, and Fox, 2008). In these markets, investors got the opportunity to take positions in unexpected fluctuations of macroeconomic risks by betting on the outcomes of various macroeconomic indicators. Remarkably, the prices of these macro-economic derivatives appear to be biased towards an equal weighted prior belief over each partition, which is clearly at odds with the rational expectations of the 'homo-economicus'.

[5] Related to this, people tend to seek for causality when examining information by looking for factors that would cause the event or behavior under consideration, even when events are random (Ajzen, 1977).

Besides these cognitive factors, emotions have a large influence on beliefs as well (see Loewenstein, Weber, Hsee and Welch, 2001, for a more extensive review). For example, happier people tend to assign higher probabilities to positive events (Wright and Bower, 1992), and people who experience stronger fear (anger) make more pessimistic (optimistic) risk estimates (Lerner, Gonzalez, Small and Fischhoff, 2003). Similar effects of emotions are found in financial markets prices. For example, Hirshleifer and Shumway (2003) find that positive moods caused by a lot of morning sunshine, lead to higher stock returns. Similarly, Edmans, Garcia and Norli (2008) find that bad moods, caused by international soccer losses in important games, predict poor returns in the loosing country the next day, especially among small stocks.

To recap, people use a variety of practices that cause beliefs to deviate from the rational beliefs of the 'homo-economicus'. People form beliefs by the degree to which an event reflects the essential characteristics of a process, by the ease with which instances come to mind, and by anchoring on initial values and adjusting this initial estimate insufficiently. Moreover, people are overconfident, too optimistic, engage in wishful thinking, bias their beliefs towards an equal chance on every possible partition, and allow emotions to influence judgments. These mental shortcuts and mistakes sometimes bias investor's expectations, which affect financial markets and its participants in a number of ways. Securities sometimes not represent their correct value, and investors who are prone to these biases will take excessive risks of which they are not aware, will experience unanticipated outcomes, and will engage in unjustified trading (see also Kahneman and Riepe, 1998).[6]

[6] As a side note, an argument often heard within the traditional finance paradigm is that these psychological findings will be eliminated by learning and experience. However, psychological work suggests otherwise; many biases are not easily eliminated by learning, repetition or bigger incentives, and they even exists among experts with substantial experience (Tversky and Kahneman, 1974, Rabin, 1998, Barberis and Thaler, 2003).

1.3.3 Psychological foundations for preferences

Behavior is largely determined by people's willingness to take risk; that is by the risk preferences people have. In contrast with the behavior of the 'homo-economicus', there exist substantive evidence showing people do not behave in accordance with (subjective) expected utility theory in many situations (see also Starmer, 2000, for an extensive overview). People systematically have preferences that differ from risk neutrality or risk aversion over the whole range of wealth. Moreover, people often value aspect other than the monetary or consumption amount, and they often do not time discount in a consistent manner. In fact, psychological work has provided some intriguing and important insights about these aspects.

First, people care about changes in wealth and care more about these changes than about the absolute value of their wealth. That is, utility depends primarily on gains and losses instead of final wealth positions (Markowitz, 1952, Kahneman and Tversky, 1979, Tversky and Kahneman, 1992). These changes are determined relative to reference points that distinguish gains from losses. For monetary outcomes the status quo generally serves as reference point (see for example Samuelson and Zeckhauser, 1988). However, it also depends on past decisions (Kahneman and Tversky, 1979, Thaler and Johnson, 1990), aspirations (Lopes, 1987, Tversky and Kahneman, 1991), expectations (Tversky and Kahneman, 1991), norms (Tversky and Kahneman, 1991), social comparisons (Tversky and Kahneman, 1991), other available alternatives and outcomes (Mellers, 2000), and other possible anchors and context factors.

Second, people treat losses (i.e. negative deviations from reference point) different from gains. People generally care disproportionally more about losses than about gains (that is, losses tend to loom larger than gains), a finding labeled "loss aversion" (see Kahneman and Tversky, 1979, Tversky

and Kahneman 1991, 1992). This loss aversion has proved to be one of the main drivers of decisions.[7]

Third, people are risk averse over gains and risk seeking over losses (Kahneman and Tversky, 1979, Tversky and Kahneman, 1992).[8] A common psychological finding is that people tend to evaluate departures from the reference point with diminishing sensitivity, meaning that an absolute deviation from the reference point that increases from 1% to 2%, is perceived as a bigger increase than a change from 30% to 31%. Therefore, people's utility functions are generally concave for gains and convex for losses. However, this does not hold for so-called ruin-losses. People want to avoid these large possible losses and tend to behave risk averse, but in an extreme sense, in the face of them (Libby and Fishburn, 1977, Kahneman and Tversky, 1979, and Laughhunn, Payne and Crum, 1980).

Fourth, people systematically deviate from weighting consequences by their probability (Kahneman and Tversky, 1979, Tversky and Kahneman, 1992). Movements of probability from zero (e.g. from 0.00 to 0.01) are given much more weight than similar movement in moderate probabilities (e.g. from 0.30 to 0.31), called the "possibility effect". Similarly, movements of probability from one (e.g. from 1.00 to 0.99) are given much more weight than similar movement in moderate probabilities (e.g. from 0.31 to 0.30), called the "certainty effect". In general, people tend to overweight small probabilities, and underweight moderate to high probabilities, where the underweighting of high probabilities is especially pronounced. This behavioral pattern implies an inverse S-shaped relation

[7] In fact, recent evidence traced the 'origins' of this loss aversion using brain analyses (see Tom, Fox, Trepel and Poldrack, 2007).

[8] For more detailed evidence, see Currim and Sarin (1989), Fennema and Van Assen (1999), Abdellaoui (2000) and Abdellaoui, Vossman and Weber (2005). In addition, Wakker and Deneffe (1996), Wu and Gonzalez (1996), Gonzalez and Wu (1999) and Camerer and Ho (1994) find evidence in favor of concavity for gains, but they have not investigated the loss domain.

between probabilities and their decision weights.[9] In addition, extremely small probabilities tend to be ignored (Kahneman and Tversky, 1979).

The above four behavioral patterns are summarized in Prospect Theory (PT, Kahneman and Tversky, 1979) and its generalization, Cumulative Prospect Theory (CPT, Tversky and Kahneman, 1992), which is nowadays known as the best descriptive theory of decisions under risk. This theory states that people behave as if they maximize

$$\sum_{i=1}^{k} w^{-}(p_i)\lambda v(x_i) + \sum_{j=k+1}^{n} w^{+}(p_j)v(x_j) \tag{1.3}$$

where

$$v(x_i) = \begin{cases} x_i^{\alpha} & if \quad x_i > 0 \\ 0 & if \quad x_i = 0 \\ -\lambda(-x_i)^{\beta} & if \quad x_i < 0 \end{cases} \tag{1.4}$$

$$w\ (p_i) = \frac{p_i^{\gamma}}{(p_i^{\gamma} + (1-p_i)^{\gamma})^{1/\gamma}} \tag{1.5}$$

and $\lambda > 1$ is the loss aversion parameter, where $w^{-}(p_i)$ and $w^{+}(p_j)$ are decision weights for the negative and positive domain, that are calculated based on the probabilities (in PT) or cumulative rank-dependent probabilities (in CPT), $v(x_i)$ is the value function, and one considers a

[9] For more evidence, see Abdellaoui, Bleichrodt and Pinto (2000), Camerer and Ho (1994), Currim and Sarin (1989), Gonzalez and Wu (1999), Tversky and Kahneman (1992), Wu and Gonzalez (1996, 1999), and Abdellaoui, Vossman and Weber (2005).

gamble with outcomes $x_1 \leq \ldots \leq x_k \leq 0 \leq x_{k+1} \leq \ldots \leq x_n$ having probabilities $p_1, \ldots, p_n$.[10, 11]

These four behavioral patterns imply that decisions are sensitive to the way alternatives are presented, or 'framed', something that has received a lot of empirical support (see especially Kahneman and Tversky, 2000, and Tversky and Kahneman, 1986). In general, a difference between two options gets more weight if it is viewed as a difference between two disadvantages than if it is viewed as a difference between two advantages (Tversky and Kahneman, 1991). For example, presenting decisions in terms of the number of lives that can be saved results in more cautious choices than presenting the same decisions in terms of lives that can be lost (Tversky and Kahneman, 1981). Moreover, people tend to prefer their current situation and are reluctant to undo or change effects of previous decisions, called the "status-quo bias". In fact, this bias is commonly observed among participants in retirement programs. In many of these programs, participants tend to maintain their previous asset allocations, despite large variations in return and hence their portfolio's risk-return trade-off (Samuelson and Zeckhauser, 1988). Furthermore, people tend to pay account to sunk costs (including time invested) and underweight opportunity costs (Thaler, 1980). In addition, many people tend to demand much more in order to give up an object they own than they would be willing to pay for it to acquire (Thaler, 1980, Kahneman, Knetsch and Thaler, 1990).

An increasing number of studies show that the four properties have substantial impact on financial markets. For example, Benartzi and Thaler (1995) show that loss aversion is an important aspect in explaining why stocks historically earn substantially higher returns than bonds. In

[10] In fact, for $0.27 < \gamma < 1$ the probability weighting function has the inverse S-shape, for $0 < \alpha < 1$ the value function is concave for gains and for $0 < \beta < 1$ the value function is convex for losses.

[11] However, other forms are proposed as well for the value function and probability weighting function, see for example Prelec (1998) and Gonzalez and Wu (1999).

addition, Genoseve and Mayer (2001) find that loss aversion drivers seller behavior in the housing market. Due to the disproportionally higher aversion for losses than for gains, people get reluctant to sell their house below the purchase price. This result in asking (but also actual selling!) prices to be higher for houses purchased at higher prices than similar other property purchased at lower prices. Moreover, Baltussen, Post and Van Vliet (2008), find that the value premium (i.e. the finding that firms with a high measure of their fundamental value relative to their market value earn higher (risk-adjusted) returns than stocks with a low measure) is severely reduced for investors with a substantial fixed income exposure, an aversion to losses, and an annual evaluation horizon. Furthermore, one of the most robust facts about the trading behavior of individual investors is the tendency of investor to hold onto stocks that have lost in value (relative to the purchase price) and to sell stocks that have risen in value, also called the "disposition effect" (Shefrin and Statman, 1985). Barberis and Xiong (2009) find that this behavior can be explained by people disliking incurring losses much more than they enjoy making gains, in combination with people's willingness to gamble in the domain of losses. Besides this, Barberis and Huang (2008) show that probability weighting leads investors to prefer positive skewness in individual securities. Among others, this results in the empirically observed relatively low returns on positively skewed securities, like Initial Public Offerings (Ritter, 1991), distressed stocks (Campbell, Hilscher and Szilagyi, 2006), and private equity holdings (Moskowitz and Vissing-Jorgensen, 2002), as well as the relatively high (low) returns on winner stocks that show (do not show) a positive return in most months of the past year (Grinblatt and Moskowitz, 2004).

Another important implication of (C)PT and its main properties is that people are generally risk seeking (i.e. they like risk) for options that have a low probability on a high gain or a high probability on a small loss. By contrast, people are risk averse (i.e. they dislike risk) for options that have a high probability on a low gain or a low probability on a big loss. In fact,

in financial like environments (i.e. environments that involve many alternatives with many possible outcomes) people tend to prefer a high level of security that is combined with some upside potential (see also Lopes, 1987, Lopes and Oden, 1999). These situations minimize fear and maximize hope, a pattern that resembles a preference for downside protection and upward potential, as is for example observed in the aggregate behavior of the stock market (Post and Levy, 2005).

Besides the above mentioned behavioral patterns, some other deviations from rational expected utility decisions are known. People's preferences are sensitive to previously experienced outcomes, implying that their preferences are path-dependent (Thaler and Johnson, 1990). In situations in which people have previously experienced a win and cannot lose that entire win within the current decision, they tend to take more risk than without a previous outcome (called the "house-money" effect). The same holds for situations in which people have experienced a loss and have a chance to make up that loss (called the "break-even" effect). Post, Van den Assem, Baltussen and Thaler (2008) show that this latter behavior happens even if no real losses are at stake, but losses are felt on "paper" only. More specific, they analyze choices made in the popular TV game show "Deal or No Deal" and accompanying behavioral experiments. In this game show people have to make choices in decision situations that are simple and well-defined, while large monetary amounts (up to □5,000,000) are at stake. Contestants experience (paper) losses if their expected winnings fall short of previous expectations, and diminished expectations represent losses. For example, taking home □100,000 is perceived as a loss if it falls short if expectations. Their findings reveal that risk aversion decreases after earlier expectations have been shattered by unfavorable outcomes or surpassed by favorable outcomes, even with these substantial amounts at stake. In contrast to the "house-money" and "break-even" effects, people tend to display more risk averse behavior in situation in which they have previously experienced a win but risk to loose that entire

stake within the current decision situation, or in situations in which people have experienced a loss but cannot win back that entire loss.

Several real-life financial observations are consistent with this path-dependency of behavior. For example, horse race gamblers display an increasing propensity to bet on long shots at the end of the racing day, presumably in an attempt to recover earlier losses (McGlothlin, 1956). Similarly, Chicago Board of Trade proprietary traders display a greater risk appetite in afternoon trading sessions after morning losses (Coval and Shumway, 2005). Moreover, Barberis, Huang, and Santos (2001) show that this path-dependency can (in combination with loss aversion) explain the historically high returns on equities together with the predictability of stock returns at low frequency.

Another remarkable finding is that choices are influenced by other amounts that are or were available. Traditionally, the finance paradigm assumes that people only care about the absolute levels of amounts at stake. That is □100,000 is perceived as if it represents its intrinsic value of □100,000. However, Baltussen, Post and Van den Assem (2007) show that amounts appear to be primarily evaluated relative to a subjective frame of reference rather than in terms of their absolute monetary value. People seem to infer the subjective worth of money by comparing it to other amounts presented. Using a sample of choices from ten different editions of "Deal or No Deal" and accompanying experiments, they show that choices are highly sensitive to the context, as defined by the initial set of prizes in the game. In each sample, contestants respond in a similar way to the stakes relative to their initial level, even though the initial level differs widely across the various editions. A contestant who may initially expect to win tens of thousands of euros in one edition will consider an amount of □50,000, to be a larger amount than a contestant in another edition who may expect to win hundreds of thousands of euros. Hence, people irrationally value outcomes in a relative manner, even when very large amounts are at stake. In a similar vein, Stewart, Chater, Stott and Reimers (2003) show that amounts are valued relative to the other

amounts available, and Mellers, Schwartz, Ho, and Ritov (1997) find that people's preferences and feelings associated with outcomes are influenced by other possible outcomes. For example, Mellers, Schwartz, Ho, and Ritov (1997) find that people feel worse about an outcome if the outcomes not obtained are better, e.g. their subjects feel worse when winning $0 when the alternative is $60 than when the alternative is -$60.[12] Moreover, Simonsohn and Loewenstein (2006) find evidence of a similar behavioral pattern in the housing market. They show that movers arriving from cities that are more expensive spend more money on housing than movers to the same city arriving from cheaper cities, controlling for wealth and other confounding effects.

Moreover, people tend to dislike situations in which they are uncertain about the probability distribution of an option, and consequently become more averse to take risk (Elsberg, 1961). This behavior, called "ambiguity aversion" tends to attenuate or reverse for decisions with which people feel familiar, knowledgeable or competent (Heath and Tversky, 1991). For instance, Heath and Tversky find that people are willing to pay substantial premiums to bet on their own assessments, relative to events with similar but known probabilities, when they consider themselves familiar with the matter, but not vice versa. In these decisions, people still dislike the uncertainty, but have a higher sense of certainty due to a bigger feeling of control. This behavioral pattern is also observed in financial markets. Investors have a relatively large propensity to invest in companies in their country or region, companies where they generally feel more familiar with (French and Poterba, 1991, and Huberman, 2001).

In addition, there exists ample evidence showing that people do not have clear well-defined preferences for difficult or unfamiliar decisions, decisions in which they have not much experience, and in decisions that

[12] Besides behavioral evidence, there also exists brain evidence for the different appraisal of the same absolute amount over different contexts. For instance, Breiter, Aharon, Kahneman and Shizgal (2001) show that a lottery yielding an outcome of $0 invokes activation in different brain regions when $0 is the best outcome than when $0 is the worst outcome.

involve a larger number of alternatives or are complex. Instead, preferences seem to be constructed at the moment of decision (Payne, Bettman and Johnson, 1992, 1993, Slovic, 1995, Bettman, Luce, Payne, 1998, Payne, Bettman and Schkade, 1999). As a result, responses reflect both people's basic preferences for certain attributes, as well as particular heuristics and processing strategies used in the decision making process, making decisions sensitive to aspects like problem presentation and context. For example, people care about comparative considerations such as relative advantages and anticipated regret. Therefore, the value placed on alternatives depends on other presented options, as well as the composition of the current choice set (Shafir, Simonson and Tversky, 1993). Alternatives appear attractive on the background of less attractive alternatives and the tendency to prefer an alternative is enhanced (hindered) depending on whether the tradeoffs within the set under consideration are favorable (unfavorable) to that alternative (Simonson and Tversky, 1992, and Tversky and Simonson, 1993). Moreover, people tend to display "extremeness aversion", that is options with extreme values within an offered set are considered less attractive than options with intermediate values (Simonson, 1989, Simonson and Tversky, 1992). Consequently, a frequently observed behavioral pattern is a tendency to compromise, meaning that the middle alternatives appear more attractive than the extremes. This behavioral pattern is even observed among fund choices of participants in retirement plans (Benartzi and Thaler, 2002).[13]

[13] Besides this, alternatives are judged relatively to anchors, even if they are completely random and known (Ariely, Loewenstein, Prelec, 2003), and the perception of downside risk (upside potential) is strongly influenced by the worst (best) possible outcomes (Lopes, 1995) and overall probability of loss (gain), or alternatively the probability of reaching, or failing to reach, an aspiration level (Libby and Fishburn, 1977, Lopes, 1995, Payne, 2005, and Langer and Weber, 2001). Moreover, preferences depend on people having to choose among objects or value them (known as the "preference reversal" phenomenon, see Lichtenstein and Slovic, 1971, and Thaler and Tversky, 1990) and whether options are evaluated individually or jointly (Hsee, Loewenstein, Blount and Bazerman, 1999). In addition, people tend to disregard nonessential differences (Tversky, 1969), and the weight of an input is enhanced by the compatibility with the output (Tversky, Sattath and Slovic, 1988). For example, when people have to determine the price of a risky alternative, they tend to overemphasize payoffs relative to probabilities, because both the input (payoffs) and the output (prices) are expressed in monetary amounts. Similarly, when people have to make choices, the most prominent attribute tends to loom larger in

In a similar vein, people seek reasons for decisions that are made deliberatively, or at least for decision about which people think extensively, and choices depend on the reasons available (Shafir, Simonson and Tversky, 1993). In fact, people tend to avoid or defer decisions that involve a lot of conflict or for which they have no definite reason. Similarly, people tend to avoid difficult choices and opt for the defaults instead. For example, Johnson and Goldstein (2003) have found that in countries where the default choice is to be a donor have substantially higher donor rates than in countries where the default is not to be a donor. This behavioral patter also manifests itself in an important financial decision. When people have to select their retirement savings investment strategy they often opt for the default fund, even when it is a bad investment over long horizons (Madrian and Shea, 2001, Benartzi and Thaler, 2007).

Besides these cognitive factors, emotions can have a large effect on preferences too. Indeed, a number of studies show that emotions substantially influences decisions in a way that differs substantially from the 'homo-economicus' (see Loewenstein, Weber, Hsee, and Welch, 2001, and Loewenstein and Lerner, 2003). For example, emotions like fear have a strong (increasing) impact on loss aversion and the sensitivity to previous gains and losses (Shiv, Loewenstein, Bechara, Damasio and Damasio, 2005). In addition, emotional outcomes strengthen probability weighting (Rottenstreich and Hsee, 2001), making especially preferences over the extreme outcomes more misaligned with that of the 'homo-economicus'. Moreover, fear unrelated to the decision situation increases people's reluctance to take risk, whereas anger does the opposite (Lerner and Keltner, 2001, Lerner, Small and Loewenstein, 2004). Hence, sudden increases in fear (or decreases in anger) tend to increase risk aversion.

Another aspect in which people differ from the 'homo-economicus' is that people deviate from maximizing their self-interest by having other

situations where no alternative has a decisive advantage on other dimensions (Tversky, Sattath and Slovic, 1988).

regarding preferences. Most importantly, people are altruistic (they care about the welfare of others), people dislike inequity, and are reciprocal, since we want to reward those that be kind to us while we want to punish those that have deceived us (see Rabin, 1998, and Fehr and Schmidt, 2003, for a more extensive survey).

Furthermore, preferences with respect to time differ from that of the 'homo-economicus'. The most important findings are that people make relatively shortsighted decisions when some outcomes are immediate, while making relatively far-sighted decisions when all outcomes will happen in the future. In addition, people generally discount gains more heavily as losses and discount small amounts more heavily than large amounts (see Camerer and Loewenstein, 2004, for a more extensive survey).

To summarize, people's preferences deviate from the rational (S)EU preferences of the 'homo-economicus'. Most importantly, people care about changes in wealth, people treat losses differently from gains, people are risk seeking for losses, people weight probabilities differently than they should, people are sensitive to previous outcomes, people value outcomes relative to other outcomes, people sometimes construct preferences at the moment of decision, people's decisions are influenced by the reasons available for a choice, people's preferences are influenced by irrelevant emotions, people have other regarding preferences, and people tend to time-discount in an inconsistent manner. Among others, this may results in high returns on equities relative to bonds, predictability in long term stock returns, investors taking too much risk after losses, investors investing too much of their money in companies located in their region, and people inefficiently investing their retirement money in the default fund.

1.3.4 Limits to Arbitrage

The field of behavioral finance argues that behavior that differs from that of the 'homo-economicus' may cause prices in financial markets to deviate from its fundamental value. A classic objection to the field of behavioral finance is that, even though some agents are less than fully rational, rational traders will quickly exploit and undo mispricing or misallocations caused by the less rational traders. That is markets succumb to efficiency. However, Barberis and Thaler (2003) point out that this objection rests on the important assertion that mispricing creates an attractive, risk-free and costless investment opportunity for rational traders (i.e. an arbitrage opportunity) that can be exploited. Nevertheless, strategies to correct mispricing can have substantial risk and costs, thereby allowing mispricing to survive. First, it is hard to remove all fundamental risk, since arbitrage requires shorting similar securities to remove the fundamental risk. However, these similar securities do not always have the same fundamental risk, meaning that not all fundamental risk can be removed. For example, Wurgler and Zhuravskaya (2002) report that for the median stock of Standard and Poor's index inclusions the best possible substitute security explains less than 25% of its variation in daily returns.

Second, there always exists the risk that the mispricing being exploited worsens in the short run, which is known as "noise trader risk" (Shleifer and Vishny, 1997). This will result in negative returns, which again may yield substantial margin calls on the short positions. Moreover, investors may respond by withdrawing their funds and creditors may call their loans. This can force arbitrageurs to liquidate their positions too early, which may result in substantial losses. In fact, this implies that many arbitrageurs have short investment horizons (Shleifer and Vishny, 1997). A nice illustration of this noise trader risk is given by the post-merger mispricing of Royal Dutch and Shell (see Froot and Dabora, 1999). These companies agreed to merge their interests on a 60-40 basis, implying that the market value of equity of Royal Dutch should be 1.5 times the market

value of Shell. However, large relative mispricing existed for prolonged periods of time, which actually worsened during several periods.

Third, arbitrage is costly since arbitrage strategies involve implementation costs. The transactions required are subject to commissions, bid-ask spreads, and price impacts. Moreover, it may be hard or even impossible to short a stock at a reasonable price. For instance, Lamont and Thaler (2003) show how shorting costs played a major role in the substantial mispricing of many equity carve-outs (i.e. a spin-off of a minority stake in a subsidiary by means of public offering) of technology stocks. This is nicely illustrated by the carve-out of 3Com and its subsidiary Palm. At the first day of the carve-out 3Com had a value per share that was at least 75% too low relative to the market valuation of Palm. Subsequently, the mispricing weakened, but remained alive for several months.

Hence, due to these 'limits to arbitrage', rational traders will often be unable to correct deviations from fundamental value (i.e. right prices) caused by irrational traders, meaning that behavior that differs from the 'homo-economicus' influences financial markets. If it is easy to take positions and misvaluations are certain to be corrected over short periods, then arbitrageurs will correct these mispricings. By contrast, if it is difficult to take positions (e.g. due to short sale constraints and limited funds), or if there is substantial risk that mispricings are not corrected within a reasonable timeframe, arbitrage forces will not correct these mispricings (Ritter, 2003).

1.4 Conclusion

Traditionally, the finance paradigm seeks to understand financial decisions by building on optimal acting agents and market forces that correct mispricing; that is it assumes people behave rational. This paper has outlined the assumptions behind the traditional finance paradigm,

and argued that, although appealing, this concept entails strong and unrealistic assumptions about human behavior and the functioning of financial markets. Indeed, abundant evidence, both from real-life data and from experiments, shows that the traditional paradigm is too restrictive, and often gives a poor description of financial behavior and markets.

By contrast, the main thought behind behavioral finance is that investment behavior exists, that differs from what the traditional finance paradigm assumes, and that this behavior influences financial markets. By applying insights from psychology and other behavioral sciences, the field of behavioral finance tries to improve our understanding of financial decisions and their affect on market prices. This paper has described the main aspects in which actual human beings and financial markets deviate from the assumptions of the traditional finance paradigm, and the influence this has on financial decisions and outcomes. It proves that in many situations behavioral finance is a better descriptor and predictor of the behavior of financial markets and its participants than the traditional finance paradigm.

This may not be a surprise given that the field of finance has always focused on the behavior of people in financial situations and markets. How can this better be studied than building upon findings showing how people actually behave? Still, behavioral finance is a relatively young field and a lot of behavior needs to be explored further. For example, how do people construct their investment portfolios? Which heuristics do they use to choose between an overload of assets? When do assets draw their attention and what effect does this have on their chosen allocations? How can we help people in improving their allocations? Moreover, when do people become overly optimistic or pessimistic? What effect does this have on market prices? How does this aggregate into market sentiments? Furthermore, how do people respond to sudden increases of fear in markets? What does this do with their expectations and decisions, and how this affect market prices? Over and above, what determines people's personal benchmarks, or reference points? What determines the value

they assign to money or consumption? What is the influence of priming? And, how does these aspects affect financial decisions and markets? Behavioral finance is to be continued…

References

Abdellaoui, M., 2000, Parameter-free elicitation of utility and probability weighting functions, Management Science 46, 1497-1512.

Abdellaoui, M., F. Vossmann, and M. Weber, 2005, Choice-Based Elicitation and Decomposition of Decision Weights for Gains and Losses Under Uncertainty, Management Science 51, 1384.

Ajzen, I., 1977, Intuitive theories of events and the effects of base-rate information on prediction, Journal of Personality and Social Psychology 35, 303-314.

Ariely, D., G. Loewenstein and D. Prelec, 2003, Coherent Arbitrariness: stable demand curves without stable preferences, Quarterly Journal of Economics 118, 73-105.

Arthur, W. B., 1994, Inductive Reasoning and Bounded Rationality, American Economic Review 84, 406-411.

Avramov, D., 2004, Stock Return Predictability and Asset Pricing Models, Review of Financial Studies 17, 699-738.

Baker, M. P., and J. Wurgler, 2007, Investor Sentiment in the Stock Market, Journal of Economic Perspectives 21, 129-152.

Baker, M., R. Ruback, and J. Wurgler, 2006, Behavioral Corporate Finance: A Survey, In The Handbook of Corporate Finance: Empirical Corporate Finance, Espen Eckbo (Eds.), New York, Elsevier North Holland.

Baltussen, G., and G. T. Post, 2007, Irrational Diversification, Working Paper, http://ssrn.com/abstract=625942

Baltussen, G., G. T. Post, and M. J. Van den Assem, 2007, Risky Choice and the Effect of the Relative Size of Stakes, Working Paper, http://ssrn.com/abstract=989242.

Baltussen, G., G. T. Post, and P. Van Vliet, 2008, Downside Risk Aversion, Fixed Income Exposure, and the Value Premium Puzzle, Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1343018.

Banz, R. W., 1981, The Relationship between Return and Market Value of Common Stocks, Journal of Financial Economics 9, 3-18.

Barber, B. M., and T. Odean, 2000, Trading is hazardous to your wealth: the common stock investment performance of individual investors, Journal of Finance 55, 773–806.

Barber, B. M., and T. Odean, 2002, Online investors: do the slow die first?, Review of Financial Studies 15, 455–488.

Barberis, N., and M. Huang, 2001, Mental Accounting, Loss Aversion, and Individual Stock Returns, Journal of Finance 56, 1247-1292.

Barberis, N. and M. Huang, 2008, Stock as Lotteries: The Implications of Probability Weighting for Security Prices, American Economic Review, forthcoming.

Barberis, N., M. Huang, and T. Santos, 2001, Prospect Theory and Asset Prices, Quarterly Journal of Economics 116, 1-53.

Barberis, N., and A. Shleifer, 2003, Style investing, Journal of Financial Economics 68, 161–199.

Barberis, N., A. Shleifer, and R. Vishny, 1998, A model of investor sentiment, Journal of Financial Economics 49, 307–343.

Barberis, N. and R. H. Thaler, 2003, A survey of behavioral finance, In Handbook of the Economics of Finance, G. Constantinides, M. Harris and R. Stulz (Eds.), North-Holland, Amsterdam.

Barberis, N, and W. Xiong, 2009, What Drives the Disposition Effect? An Analysis of a Long-standing Preference-based Explanation, Journal of Finance 64, 751-784.

Basu, S., 1977, Investment Performance of Common Stocks in Relation to their Price-Earnings Ratios: A Test of the Efficient Market Hypothesis, Journal of Finance 32, 663–682.

Benartzi, S., 2001,.Excessive extrapolation and the allocation of 401(k) accounts to company stock, Journal of Finance 56, 1747–1764.

Benartzi, S., and R. H. Thaler, 1995, Myopic Loss Aversion and the Equity Premium Puzzle, Quarterly Journal of Economics 110, 73-92.

Benartzi, S., and R. H. Thaler, 1999, Risk Aversion Or Myopia? Choices in Repeated Gambles and Retirement Investments, Management Science 45, 364-381.

Benartzi, S., and R. H. Thaler, 2001, Naïve Diversification Strategies in Defined Contribution Saving Plans, American Economic Review 91, 79-98.

Benartzi, S. and R. H. Thaler, 2002, How Much is Investor Autonomy Worth?, Journal of Finance 57, 1593-1616.

Benartzi, S. and R. H. Thaler, 2004, Save more tomorrow: using behavioral economics to increase employee saving, Journal of Political Economy 112, 164–187.

Benartzi, S., and R. H. Thaler, 2007, Heuristics and Biases in Retirement Savings Behavior, Journal of Economic Perspectives 21, 81-104.

Bernard, V. and J. Thomas, 1989, Post-earnings-announcement drift: delayed price response or risk premium?, Journal of Accounting Research 27, 1–48.

Bettman, J. R., M. F. Luce, and J. W. Payne, 1998, Constructive Consumer Choice Processes, Journal of Consumer Research 25, 187-217.

Bleichrodt, H., and J. L. Pinto, 2000, A Parameter-Free Elicitation of the Probability Weighting Function in Medical Decision Analysis, Management Science 46, 1485-1496.

Breiter, H. C., I. Aharon, D. Kahneman, A. Dale, and P. Shizgal, 2001, Functional imaging of neural responses to expectancy and experience of monetary gains and losses, Neuron 30, 619–639.

Camerer, C. F., and T. H. Ho, 1994, Violations of the Betweenness Axiom and Nonlinearity in Probability, Journal of Risk and Uncertainty 8, 167-196.

Camerer, C. F. and G. Loewenstein, 2004. Behavioral Economics: Past, Present, and Future, In Advances in Behavioral Economics, C. F. Camerer, G. Loewenstein and M. Rabin (Eds.), New York: Russell Sage Foundation.

Campbell, J. Y., 2000, Asset pricing at the millennium, Journal of Finance 55, 515-67.

Campbell, J. Y., 2006, Household finance, Journal of Finance 61, 1553–1604.

Campbell, J. Y., J. Hilscher, and J. Szilagyi, 2006, In Search of Default Risk, Journal of Finance, forthcoming.

Conlisk, J., 1996, Why Bounded Rationality? Journal of Economic Literature 34, 669-700.

Cooley, P. L., 1977, A Multidimensional Analysis of Institutional Investor Perception of Risk, Journal of Finance 32, 67-78.

Coval, J. D., and T. Shumway, 2005, Do Behavioral Biases Affect Prices?, Journal of Finance 60, 1-33.

Cremers, K. J. M., 2002, Stock Return Predictability: A Bayesian Model Selection Perspective, Review of Financial Studies 15, 1223-1249.

Currim, I. S., and R. Sarin, 1989, Prospect Versus Utility, Management Science 35, 22-41.

Daniel, K. D., D. Hirshleifer, and A. Subrahmanyam, 1998, Investor psychology and security market under and over-reactions, Journal of Finance 53, 1839–1886.

De Bondt, W. F. M., 1993, Betting on Trends: Intuitive Forecasts of Financial Risk and Return, International Journal of Forecasting 9, 355-371.

De Bondt, W. F. M., 1998, A Portrait of the Individual Investor, European Economic Review 42, 831-844.

De Bondt, W. F. M., and R. H. Thaler, 1985, Does the stock market overreact? Journal of Finance 40, 793–805.

De Bondt, W. F. M., and R. H. Thaler, 1987, Further Evidence on Investor Overreaction and Stock Market Seasonality, Journal of Finance 42, 557-581.

De Bondt, W. F. M., and R. H. Thaler, 1995, Financial decision-making in markets and firms: a behavioral perspective. In Finance, Handbooks in Operations Research and Management Science, Vol. 9, Jarrow, R.A., Maksimovic, V., Ziemba, W.T. (Eds.), North Holland, Amsterdam.

Edmans, A., D. Garcia, and N. Øyvind, 2008, Sports Sentiment and Stock Returns, Journal of Finance. 62, 1967-1998.

Ellsberg, D., 1961, Risk, Ambiguity, and the Savage Axioms, Quarterly Journal of Economics 75, 643–669.

Fama, E. F., and K. R. French, 1988, Dividend yields and expected stock returns, Journal of Financial Economics 22, 3–27.

Fama, E. F., and K. R. French, 1989, Business Conditions and Expected Returns on Stocks and Bonds, Journal of Financial Economics 25, 23-49.

Fama, E. F., and K. R. French, 1992, The Cross-Section of Expected Stock Returns, Journal of Finance 47, 427-465.

Fama, E. F., and K. R. French, 1993, Common Risk Factors in the Returns on Stocks and Bonds, Journal of Financial Economics 33, 3-56.

Fehr, E. and K. M. Schmidt, 2003, Theories of fairness and reciprocity – evidence and economic applications, In Advances in Economics and Econometrics – 8th World Congress, M. Dewatripont, L. Hansen and St. Turnovsky (Eds.), Cambridge, Cambridge University Press 2003.

Fennema, H., and M. Van Assen, 1998, Measuring the Utility of Losses by Means of the Tradeoff Method, Journal of Risk and Uncertainty 17, 277-296.

Fox, C. R., and R. T. Clemen, 2005, Subjective Probability Assessment in Decision Analysis: Partition Dependence and Bias Toward the Ignorance Prior, Management Science 51, 1417-1432.

French, K. R., and J. M. Poterba, 1991, Investor Diversification and International Equity Markets, American Economic Review 81, 222-226.

Froot K. A. and E. A. Dabora, 1999, How are stock prices affected by the location of trade?, Journal of Financial Economics 53, 189–216.

Gabaix, X., and D. Laibson, 2000, A Boundedly Rational Decision Algorithm, American Economic Review 90, 433-438.

Genesove, D., and C. Mayer, 2001, Loss Aversion and Seller Behavior: Evidence from the Housing Market, Quarterly Journal of Economics 116, 1233-1260.

Gneezy, U., and J. Potters, 1997, An experiment on risk taking and evaluation periods, Quarterly Journal of Economics 112, 631–645.

Goetzmann, W. N., and A. Kumar, 2008, Equity portfolio diversification, Review of Finance 12, 433-463.

Grinblatt, M., and T. J. Moskowitz, 2004, Predicting Stock Price Movements From Past Return: The Role of Consistency and Tax-Loss Selling, Journal of Financial Economics, 71, 541–579.

Haigh, M., and J. A. List, 2005, Do Professional Traders Exhibit Myopic Loss Aversion? An Experimental Analysis, Journal of Finance 60, 523-534.

Heath, C., and A. Tversky, 1991, Preferences and Beliefs: Ambiguity and Competence in Choice Under Uncertainty, Journal of Risk and Uncertainty 4, 5-28.

Hirshleifer, D., 2001, Investor psychology and asset pricing, Journal of Finance 56, 1533–1597.

Hirshleifer, D. and T. Shumway, 2003, Good day sunshine: Stock returns and the weather, Journal of Finance 58, 1009–1032.

Hong, H. and J. C. Stein, 1999, A unified theory of underreaction, momentum trading and overreaction in asset markets, Journal of Finance 54, 2143–2184.

Hsee, C. K., G. Loewenstein, S. Blount and M. H. Bazerman, 1999, Preference Reversals between Joint and Separate Evaluations of Options: A Review and Theoretical Analysis, Psychological bulletin 125, 576-590.

Huberman, G., 2001, Familiarity breeds investment, Review of Financial Studies 14, 659– 680.

Huberman, G., and W. Jiang, 2006, Offering versus Choice in 401(k) Plans: Equity Exposure and Number of Funds, Journal of Finance 61, 763-801.

Jegadeesh, N. and S. Titman, 1993, Returns to buying winners and selling losers: implications for stock market efficiency, Journal of Finance 48, 65–91.

Johnson, E. J., and D. Goldstein, 2003, Do Defaults Save Lives, Science 302, 1338–39.

Kahneman, D., 1973,. Attention and Effort. Englewood Cliffs, NJ: Prentice-Hall.

Kahneman, D, 2003, Maps of Bounded Rationality: Psychology for Behavioral Economics, American Economic Review 93, 1449-1475

Kahneman, D., J. Knetsch, and R. H. Thaler, 1990, Experimental tests of the endowment effect and the Coase theorem, Journal of Political Economy 98, 1325-1348.

Kahneman, D., and D. Lovallo, 1993, Timid choices and bold forecasts: A cognitive perspective on risk taking, Management Science 39, 17–31.

Kahneman, D., and M. W. Riepe, 1998, Aspects of Investor Psychology, Journal of Portfolio Management 24, 52-65.

Kahneman, D., A. Schwartz, R. H. Thaler and A. Tversky, 1997, The Effect of Myopia and Loss Aversion on Risk Taking: An Experimental Test, Quarterly Journal of Economics 112, 647-661.

Kahneman, D., and A. Tversky, 1971, Belief in the Law of Small Numbers, Psychological bulletin 76, 105-110.

Kahneman, D., and A. Tversky, 1972, Subjective Probability: A Judgment of Representativeness, Cognitive psychology 3, 430-454.

Kahneman, D., and A. Tversky, 1973, On the Psychology of Prediction. Psychological review 80, 237-251.

Kahneman, D., and A. Tversky, 1979, Prospect Theory: An Analysis of Decision Under Risk, Econometrica 47, 263-291.

Kahneman, D., and A. Tversky, 1991, Loss Aversion in Riskless Choice: A Reference-Dependent Model, Quarterly Journal of Economics 106, 1039-1061.

Kahneman, D, and A. Tversky, 2000, Choices, Values and Frames (Eds.), New York: Cambridge University Press and the Russell Sage Foundation.

Kothari, S. P., 2001, Capital markets research in accounting, Journal of Accounting and Economics 31, 105–231.

Kroll, Y., and H. Levy, 1992, Further Tests of the Separation Theorem and the Capital Asset Pricing Model, American Economic Review Review 82, 664-670

Kroll, Y., H. Levy, and A. Rapoport, 1988, Experimental Tests of the Separation Theorem and the Capital Asset Pricing Model, American Economic 78, 500-519.

Lamont, O., and R. H. Thaler, 2003, Can the market add and subtract? Mispricing in tech stock carve-outs, Journal of Political Economy 111, 227–268.

Langer, E. J., 1975, The illusion of control, Journal of Personality and Social Psychology 32, 311–328.

Langer, T., and M. Weber, 2001, Prospect Theory, Mental Accounting, and Differences in Aggregated and Segregated Evaluation of Lottery Portfolios, Management Science 47, 716-733.

Laughhunn, D. J., J. W. Payne, and R. Crum, 1980, Managerial Risk Preferences for Below-Target Returns, Management Science 26, 1238-1249.

Lerner, J. S., R. M. Gonzalez, D. A. Small, and B. Fischhoff, 2003, Effects of fear and anger on perceived risks of terrorism: A national field experiment, Psychological Science 14, 144-150.

Lerner, J. S., and D. Keltner, 2001, Fear, anger, and risk, Journal of Personality and Social Psychology 81, 146-159.

Lerner, J. S., D. A. Small, and G. Loewenstein, 2004, Heart strings and purse strings: Carry-over effects of emotions on economic transactions, Psychological Science 15, 337-341.

Libby, R., and P. C. Fishburn, 1977, Behavioral Models of Risk Taking in Business Decisions: A Survey and Evaluation, Journal of Accounting Research 15, 272-292.

Lichtenstein, S., B. Fischhoff, and L. D. Phillips, 1982, Calibration of Subjective Probabilities: The State of the Art Up to 1980, (Cambridge University Press, 306-334.

Lichtenstein, S., and P. Slovic, 1971, Reversals of Preference between Bids and Choices in Gambling Situations, Journal of Experimental Psychology 89, 46-55.

Loewenstein, G., E. U. Weber, C. K. Hsee and N. Welch, 2001, Risk as Feelings, Psychological bulletin 127, 267-286.

Loewenstein, G., and J. S. Lerner, 2003, The role of affect in decision making, In Handbook of Affective Science, R. Davidson, H. Goldsmith, and K. Scherer (Eds.), Oxford: Oxford University Press.

Lopes, L. L., 1987, Between hope and fear: The psychology of risk, Advances in Experimental Social Psychology 20, 255-295.

Lopes, L. L., 1995, Algebra and process in the modeling of risky choice, In Decision making from a cognitive perspective 32, J. Busemeyer, R. Hastie, and D. L. Medin (Eds.), San Diego:Academic Press.

Lopes, L. L., and G. C. Oden, 1999, The Role of Aspiration Level in Risky Choice: A Comparison of Cumulative Prospect Theory and SP/A Theory, Journal of mathematical psychology 43, 286-313.

Lord, C. G., L. Ross, and M. R. Lepper, 1979, Biased Assimilation and Attitude Polarization: The Effects of Prior Theories on Subsequently Considered Evidence, Journal of Personality and Social Psychology 37, 2098-2109.

Madrian, B. C., and D. F. Shea, 2001, The Power of Suggestion: Inertia in 401 (k) Participation and Savings Behavior, Quarterly Journal of Economics 116, 1149-1187.

Markowitz, H. M., 1952, The Utility of Wealth, Journal of Political Economy 60, 151-158.

McGlothlin, W. H., 1956, Stability of Choices among Uncertain Alternatives, American Journal of Psychology 69, 604-615.

Mehra, R., and E. C. Prescott, 1985, The equity premium: A puzzle, Journal of Monetary Economics 15, 145–161.

Mellers, B.A., A. Schwartz, K. Ho, and I. Ritov, 1997, Decision affect theory: emotional reactions of the outcomes of risky options, Psychological. Science 8, 423–429.

Miller, G. A., 1956, The magical number seven plus or minus two: Some limits on our capacity for processing information. *Psychological Review* 63, 81-97.

Moskowitz, T. J., and A. Vissing-Jorgenson, 2002, The returns to entrepreneurial investment a private equity premium puzzle?, American Economic Review 92, 745–778.

Newell, A., and H. A. Simon, 1972, Human problem solving,. Englewood Cliffs, NJ: Prentice-Hall.

Odean, T., 1998, Are investors reluctant to realize their losses? Journal of Finance 53, 1775–1798.

Odean, T., 1999, Do investors trade too much?, American Economic Review 89, 1279–1298.

Payne, J. W., 1976, Task Complexity and Contingent Processing in Decision Making: An Informational Search and Protocol Analysis, Organizational Behavior and Human Performance 16, 366-387.

Payne, J. W., 2005, It is Whether You Win Or Lose: The Importance of the overall Probabilities of Winning Or Losing in Risky Choice, Journal of Risk and Uncertainty 30, 5-19.

Payne, J.W., Bettman, J. R. and E. J Johnson, 1992, Behavioral decision research: A constructive processing perspective, Annual Review of Psychology 43, 87–131.

Payne, J.W., Bettman, J. R. and E. J. Johnson, 1993, The adaptive decision maker, Cambridge University Press.

Payne, J. W., J. R. Bettman, and D. A. Schkade, 1999, Measuring Constructed Preferences: Towards a Building Code, Journal of Risk and Uncertainty 19, 243-270.

Post, G. T., and H. Levy, 2005, Does Risk Seeking Drive Stock Prices? A Stochastic Dominance Analysis of Aggregate Investor Preferences and Beliefs, Review of Financial Studies 18, 925-953.

Post, G. T., M. J. Van den Assem, G. Baltussen and R. H. Thaler, 2008, Deal or No Deal? Decision Making Under Risk in a Large-Payoff Game Show, American Economic Review 98, 38-71.

Prelec, D., 1998, The Probability Weighting Function, Econometrica 66, 497-527.

Rabin, M., 1998, Psychology and Economics, Journal of Economic Literature 36, 11-46.

Read, D. and G. Loewenstein, 1995, Diversification Bias: Explaining the Discrepancy in Variety Seeking between Combined and Separated Choices, Journal of Experimental Psychology: Applied 1, 34-49.

Read, D., G. Loewenstein, and M. Rabin, 1999, Choice bracketing, Journal of Risk and Uncertainty 19, 171–197.

Redelmeier, D., and A. Tversky, 1992, On the framing of multiple prospects, Psychological Science 3, 191–193.

Ritter, J., 1991, The long-term performance of initial public offerings, Journal of Finance 46, 3–27

Ritter, J. R., 2003, Behavioral finance, Pacific-Basin Finance Journal 11, 429-437.

Rottenstreich, Y, and C. K. Hsee, 2001, Money, Kisses and Electric Shocks: On the Affective Psychology of Risk, Psychological Science 12, 185-190.

Samuelson, W., and R. Zeckhauser, 1988, Status Quo Bias in Decision Making, Journal of Risk and Uncertainty 1, 7-59.

Savage, L. J., 1954, The Foundations of Statistics,. New York, NY: Wiley

Shafir, E., I. Simonson, and A. Tversky, 1993, Reason-Based Choice, Cognition 49, 11-36.

Shefrin, H. and M. Statman, 1984, Explaining investor preference for cash dividends, Journal of Financial Economics 13, 253–282.

Shefrin, H. and M. Statman, 1985. The disposition to sell winners too early and ride losers too long: Theory and evidence. Journal of Finance 40,777-790.

Shefrin, H. M., and R. H. Thaler, 1981, An Economic Theory of Self-Control, Journal of Political Economy 89, 392-406.

Shiv, B., G. Loewenstein, A. Bechara, H. Damasio, A. R. Damasio, 2005, Investment Behavior and the Negative Side of Emotion, Psychological Science 16, 435-439.

Shleifer A., and R. Vishny, 1997, The limits of arbitrage, Journal of Finance 52, 35–55.

Simon, H. A., 1955, A Behavioral Model of Rational Choice, Quarterly Journal of Economics 69, 99-118.

Simon, H. A., 1957, Models of man, New York: Wiley & Sons.

Simon, H. A., 1959, Theories of Decision-Making in Economics and Behavioral Science, American Economic Review 49, 253-283.

Simon, H. A., 1979, Rational Decision Making in Business Organizations, American Economic Review 69, 493-513.

Simonsohn, U., and G. Loewenstein, 2006, Mistake #37: The Effect of Previously Encountered Prices on Current Housing Demand, The Economic Journal 116, 175–199.

Simonson, I., 1989, Choice Based on Reasons: The Case of Attraction and Compromise Effects, Journal of Consumer Research 16, 158–174.

Simonson, I., and A. Tversky, 1992, Choice in Context: Tradeoff Contrast and Extremeness Aversion, Journal of Marketing Research 29, 281-295.

Slovic, P., 1972, Information Processing, Situation Specificity, and the Generality of Risk-Taking Behavior. Journal of Personality and Social Psychology 22, 128-134.

Slovic, P., 1995, The Construction of Preference, American Psychologist 50, 364-371.

Sonnemann, U., C. F. Camerer, T. Langer, and C. R. Fox, 2008, Partition-Dependent Framing Effects in Lab and Field Prediction Markets, Working Paper, http://ssrn.com/abstract=1099073.

Starmer, C., 2000, Developments en Non-Expected Utility Theory: The Hunt for a Descriptive Theory of Choice under Risk, Journal of Economic Literature 38, 332-382.

Stewart, N., N. Chater, H. P. Stott, and S. Reimers, 2003, Prospect relativity: How choice options influence decision under risk, Journal of Experimental Psychology: General 132, 23-46.

Stracca, L., 2004, Behavioral Finance and Asset Prices: Where do we Stand? Journal of Economic Psychology 25, 373-405.

Thaler, R. H., 1980, Toward a positive theory of consumer choice, Journal of Economic Behavior and Organization 39, 36-90.

Thaler, R. H., 1985, Mental Accounting and Consumer Choice, Marketing Science 4, 199-214.

Thaler, R. H., 1999, Mental Accounting Matters, Journal of Behavioral Decision Making 12, 183- 206.

Thaler, R.H. and E.J. Johnson, 1990, Gambling with the House Money and Trying to Break Even: The Effects of Prior Outcomes on Risky Choice, Management Science 36, 643-660.

Thaler, R. H. and A. Tversky, 1990, Preference Reversals, Journal of Economic Perspectives 4, 201-211.

Tom, S., C. R. Fox, C. Trepel, and R. A. Poldrack, 2007, The neural basis of loss aversion in decision making under risk, Science 315, 515-518.

Tversky, A., 1969, Intransitivity of Preferences, Psychological review 76, 31-48.

Tversky, A., 1972, Elimination by aspects: A theory of choice", Psychological review 79, 281-299.

Tversky, A., and D. Kahneman, 1974, Judgment under uncertainty: Heuristics and biases, Science 185, 1124-1131.

Tversky, A., and D. Kahneman, 1981, The Framing of Decisions and the Psychology of Choice, Science 211, 453–458.

Tversky, A., and D. Kahneman, 1983, Extensional Versus Intuitive Reasoning: The Conjunction Fallacy in Probability Judgment, Psychological review 90, 293-315.

Tversky, A., and D. Kahneman, 1986, Rational choice and the framing of decisions, Journal of Business 59, S251-S278.

Tversky, A., and D. Kahneman, 1992, Advances in Prospect Theory: Cumulative Representation of Uncertainty, Journal of Risk and Uncertainty 5, 297-323.

Tversky, A., S. Sattath, and P. Slovic, 1988, Contingent Weighting in Judgment and Choice, Psychological review 95, 371-384.

Tversky, A., and I. Simonson, 1993, Context-Dependent Preferences, Management Science 39, 1179-1189.

Von Neumann, J., and O. Morgenstern, 1944, Theory of Games and Economic Behavior. Princeton, NJ: Princeton University Press.

Wakker, P. P., and D. Deneffe, 1996, Eliciting Von Neumann-Morgenstern Utilities when Probabilities are Distorted Or Unknown, Management Science 42, 1131-1150.

Weinstein, N. D., 1980, Unrealistic Optimism about Future Life Events, Journal of personality and social psychology 39, 806-820.

Whitelaw, R. F., 1994, Time Variations and Covariations in the Expectation and Volatility of Stock Market Returns, Journal of Finance 49, 515-541.

Wright, W. F., and G. H. Bower, 1992, Mood effects on subjective probability assessment, Organizational Behavior and Human Decision Processes 52, 276–291.

Wu, G., and R. Gonzalez, 1996, Curvature of the probability weighting function, Management Science 42, 1676-1690.

Wurgler, J., K. Zhuravskaya, 2002, Does arbitrage flatten demand curves for stocks?, Journal of Business 75, 583–608.