Regulating retirement savings: An evolutionary psychology approach

Regulering van pensioensparen: Een benadering vanuit de evolutionaire psychologie

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Table of Abbreviations

401(k) Plan	A defined contribution pension plan that qualifies for tax benefits under section 401(k) of the U.S. Internal Revenue Code
CAPM	Capital Asset Pricing Model
CPP	Canada Pension Plan
DB Plan	Defined benefit pension plan
DC Plan	Defined contribution pension plan
DOSPERT Scale	Domain-Specific Risk-Taking Scale
I-PANIS-SF	International Positive and Negative Affect Schedule, Short-form
IOS Scale	Inclusion of Others in Self Scale
OECD	The Organisation for Economic Co-operation and Development
OFC	Orbitofrontal Cortex region of the brain
OLS	Ordinary Least Squares
PAYG	Pay As You Go Pension Plan
SES	Socio-Economic Status
U.K.	United Kingdom
U.S.	United States of America

Chapter 1: Introduction

1. Background

In many countries, responsibility for retirement savings planning has been shifting from governments and employers to individuals. A concern with this shift in responsibility is that individuals have been shown to make systematic mistakes in all aspects of their retirement savings planning. For example, they under-contribute to their retirement savings plans, under-diversify their portfolios, pay excessive management fees and drawdown their retirement savings too soon (Barber & Odean 2013; Benartzi & Thaler 2007; Mitchell & Utkus 2004). These mistakes can be very costly. Accordingly, this shift in responsibility may be contributing to the low retirement incomes that are being observed in countries such as the U.S. (Munnell et al. 2015).

Until recently, state-provided pensions were almost always defined benefit plans, which pay a retirement income during a retiree's lifetime based on employment earnings and number of years worked. During the last couple of decades, however, governments in most developed countries and in some less developed countries started scaling back their defined benefit plans. To help compensate for the reduced defined benefit plan benefits, some governments introduced mandatory or voluntary defined contribution plans. Under a defined contribution plan, an individual's retirement income is paid solely out of contributions made by or on behalf of the individual and the income earned on those contributions. This shift from defined benefit plans to defined contribution plans is not driven by efficiency concerns, such as a belief that individuals will do a better job than the state of providing for retirement. Rather, this shift was done to allow governments more certainty in their pension costs. Moving from a defined benefit plan to a defined contribution plan shifts to individuals certain risks associated with pensions, such as the risk that funding costs will increase because of future increases in life expectancies or that investment returns will be lower than forecast. (Martin & Whitehouse 2008; European Commission 2012b; European Commission 2010).

This switch to defined contribution plans has also occurred in employer-provided pension plans. Historically, employers who provided pensions to their employees did so through defined benefit plans. However, since the beginning of the 1980's, employers in the U.S., Canada, the U.K. and other countries have moved away from providing pensions through DB plans to providing them through defined contribution plans (Brown 2016). In a typical defined contribution plan, employees contribute to the plan and the employer matches the contribution up to some limit. The employee generally chooses the contribution level and makes the investment decisions. While the trend towards defined contribution plans is not strong in Western Europe, legislation has recently been enacted in Belgium and in Germany to permit employers to offer defined contribution plans (Roessler 2017).

As alluded to in the opening paragraph, individuals make a host of systematic mistakes in managing their defined contribution plans. Traditional economists and finance scholars are puzzled by these mistakes. Two of the usual tools that traditionalists advocate for – more disclosure and better investor education – do not seem to change this behavior (Benartzi & Thaler 2007, p.99). On the other hand, establishing defaults and using other types of nudges have had a very large and lasting impact on individuals' retirement savings planning (e.g. Madrian & Shea 2001). Behavioral finance scholars and behavioral economists have done a good job of documenting the systematic mistakes that individual make in their retirement savings planning. They have identified biases and heuristics which cause people to invest in a sub-optimal manner, and they have come up with policies that lead to improved retirement planning behavior. However, they have not yet developed a unifying theory for why people are so bad at their retirement savings planning.

The motivation for writing this book is a belief that developing a framework within which to analyze why individuals make systematic mistakes in their retirements savings planning will help governments and defined contribution plan administrators to design better plans. Better crafted retirement plans may allow more people to maintain in retirement the standard of living that they enjoyed during their working years. The framework that I develop in this book for why people make these systematic mistakes is that the human brain has not evolved to easily solve problems relating to retirement savings planning. This framework is summarized in section 2 below.

2. Natural Selection and Evolutionary Psychology

The framework that I develop in this book to explain why people deviate from optimal retirement savings planning is based on Charles Darwin's theory of natural selection (Darwin 1859). The theory of natural selection simply provides that heritable traits of an organism will be selected for if they help that organism reproduce at a greater rate than others of that species. Of course, natural selection also applies to human beings. Our brains (and our cognitive abilities and biases) are the way they are because those specific attributes helped our ancestors survive and reproduce. In other words, the human brain evolved from earlier forms to what it is today because the evolved form allowed our ancestors to better solve recurring problems that they faced, such as avoiding predators, obtaining sufficient food and finding and retaining a mate (Kenrick et al. 2009).

The field of evolutionary psychology uses the theory of natural selection to explain human behaviour. It is based on a premise that, to understand the behavior of current-day human beings, one must consider the behavioral traits that would have been useful for the survival of our distant ancestors. During most of the time that the human brain was evolving, humans were hunter-gathers who lived in small groups of 150 people or less. As well, over most of that time, our social structure, environment and technology changed very slowly. It is only when we started farming about 12,000 year ago (a blink of an eye in evolutionary terms) that our social structure, environment and technology changed very rapidly, which threw up new problems that people needed to solve in order to survive and reproduce (Cosmides & Tooby 1995). Evolutionary psychologists assert that, because these changes were so rapid, natural selection has not had sufficient time to produce brains that are optimized to solve the problems that our current environment has thrown up. In other words, they assert that our brains are better suited to solving the problems that hunter-gatherers faced than to problems that arise in modern societies.

One modern problem that we face and which our hunter-gatherer ancestors did not face is saving for retirement, least of all because most hunter-gatherers did not live to an old age (Gurven & Kaplan 2007). Saving for retirement using financial markets is something that has only become possible for most people over the last few hundred years, at most. That timeframe is not nearly long enough for our brains to have evolved to effortlessly solve problems such as how

much to consume now versus how much to save and consume in decades from now. The fact that our brains are not optimized to solve retirement savings problems is not to suggest that we cannot learn to become better at tasks relating to retirement savings. People do learn to be better at saving and investing for retirement. However, because our brains did not evolve to specifically solve those tasks, solving them does not come easily to most people.

I am certainly not the first scholar to suggest that we need to consider how our brains evolved in order to explain the biases and heuristics that behavioral economists have identified. Gerd Gigerenzer's theory of ecological rationality is based on concepts of natural selection (see for example Gigerenzer 2008). Owen Jones, a legal scholar, has used principles of evolutionary psychology to analyze, among other things, criminal law (Jones & Goldsmith 2005). As well, finance scholars have started using genetics (and the interplay between genes and environment) to explain heterogeneity in investment behavior (Barnea et al. 2010; Cronqvist et al. 2015).

3. Research Questions and Methodology

The main research question of this book is whether evolutionary psychology (which itself is grounded in the theory of natural selection) can help to explain the biases and heuristics that people have been observed to use in making their retirement savings decisions. I take a multi-disciplinary approach to answering this question. I start by describing optimal investment strategies that have been developed by finance scholars and economists. I then compile and analyze in detail the evidence from finance and from behavioral economics that people systematically deviate from what finance scholars consider optimal investment strategies. I introduce evolutionary psychology and describe how that scholarship may provide a framework to explain the deviations from optimal investment strategies that we observe. I also use data from psychology and neuroscience to augment the evolutionary psychology framework. At its heart, this book is based on empirical research, both data gathered by others and on experiments which I conducted. Accordingly, I attempt to support with empirical evidence the theories and hypotheses that I develop in answering this research question.

After dealing with the broad research question, I deal with two specific research questions that follow from an evolutionary psychology analysis of retirement savings mistakes.

The two specific questions that I take on are (i) whether men under-diversify their stock holdings more when the evolutionarily important challenge of finding a mate is made salient to them and (ii) whether, in the retirement savings domain, individuals stick to defaults and make the same decisions as their peers to avoid the potential for feeling future regret.

I again use evidence from the disciplines mentioned in the opening paragraph of this section to develop hypotheses relating to each of the two specific questions. However, I go beyond formulating theories and hypotheses that are supported with available evidence. I test hypotheses relating to these two specific questions by conducting online experiments. The first experiment, on mate-seeking salience and under-diversification, is similar in approach to experiments conducted by evolutionary psychologists. The second experiment, on regret and its association with defaults and peer decisions, is incentivized and is closer in character to experiments run by economists.

Throughout the book, I assess the regulatory consequences of my theories and empirical findings using a law and economics framework.

4. Limitations

As far as I am aware, I am the first to use evolutionary psychology to formulate an evolutionary theory to explain the retirement savings mistakes that people make. The task has been formidable and I am humble enough to realize that my theories and methodology can be improved upon. One purpose of taking the evolutionary approach that I took in this book is to stimulate a conversation about the relevance to retirement savings planning of the fact that our brains are evolved organs. Therefore, I look forward to having others improve upon my work.

I have been fortunate enough to have discussed chapters of this book with evolutionary psychologists. I have also presented my work at evolutionary psychology conferences and workshops. That having been said, I do not have a formal background in evolutionary biology or evolutionary psychology. Therefore, I may not have the depth of knowledge in these subjects to know when I am making a mistake. However, because of input from those who have that depth of knowledge, I am confident that I have not made a fatal mistake.

I make no claim that the evolutionary psychology approach is the only approach to explaining why people make mistakes in their retirement savings mistakes. My claim is that the principle of natural selection can help us better understand why people make these mistakes.

I conducted only one experiment for each of the two specific research questions. Accordingly, caution should be taken in applying the results. It is possible that the results are attributable to factors other than the independent variables which were manipulated in the experiments. In addition, caution must be taken in generalizing the results of the experiments to other situations, such as actual retirement savings behaviour.

5. Content Structure

The book consists of six chapters, including this introduction. In chapter 2, I explain how natural selection and evolutionary psychology may help in developing an underlying theory as to why people makes systematic retirement savings mistakes. While the chapter is focussed on explaining why and when individuals may under-diversify their stock portfolios, the theoretical discussion on evolutionary psychology theories put forward in the chapter can be applied to questions of why and when individuals make other seemingly sub-optimal decisions relating to their retirement savings planning.

In chapter 3, I report on an experiment that was conducted to test one of the hypotheses from chapter 2. That experiment tested whether males for whom mate-seeking is made salient under-diversify their stock portfolios more than other males. The design of the experiment is similar to that of evolutionary psychology experiments which test whether males for whom mate-seeking is made salient take greater financial risk than males for whom mate-seeking is not made salient (e.g. Ermer et al. 2008; Griskevicius et al. 2012).

Regret is an emotion that helps humans learn from their mistakes. As learning from mistakes likely enhanced survival and opportunities to reproduce, having the ability to feel, anticipate and avoid regret would have been selected for (Santos & Rosati 2015). The fact that regret is a universal trait supports this view (Breugelmans et al. 2014). I hypothesize in chapter 4 that the emotion of regret may explain many of the retirement savings mistakes that individuals have been observed to make. People make retirement savings decisions partly to reduce the

potential for regret. Regret may also explain why defaults work so well in the retirement savings domain – people follow defaults because it is a regret reducing strategy.

Chapter 5 reports on an online experiment that I conducted with Pieter Desmet to test whether regret may explain why defaults and communicating peer preferences can be so effective in changing behavior. In the experiment, subjects decided between two lotteries and reported the regret they would feel if the lottery they did not choose paid out more than the lottery they chose. Like economics experiments, this experiment was incentivized – one in twenty participants were paid based on the outcome of the lottery they decided on.

Chapter 6 summarizes my main hypotheses and findings, the contribution of my work to the literature and the policy implications of my findings.

Chapter 2: Under-diversification by Individual Investors: Can Evolutionary Psychology Explain it?

> *There is no clear evidence from experience that the investment policy which is socially advantageous coincides with that which is most profitable . . . . The game of professional investment is intolerably boring and over-exacting to anyone who is entirely exempt from the gambling instinct; whilst he who has it must pay to this propensity the appropriate toll.*
>
> John Maynard Keynes, The General Theory of Employment, Interest and Money (1935), Chapter 12

Abstract

According to finance theory and supporting evidence, individual investors maximize expected returns on their stock market investments by holding a diversified stock portfolio and by limiting trading. However, a substantial subset of individual investors deviate from this strategy, causing them to earn, on average, a much lower return than if they had followed a diversified strategy. Less wealthy investors and investors who are single men deviate from portfolio theory more than other investors and, consequently, they earn low stock returns. The prevailing view in finance is that individual investors deviate from portfolio theory because of irrational overconfidence and reliance on heuristics. In contrast, the hypothesis of this chapter is that individual investors deviate from portfolio theory and accept lower rates of expected return on investment to try and satisfy other, more pressing, needs. I use evolutionary psychology to show that investors may be deviating from portfolio theory in an effort to attain evolutionarily important goals, such as to acquire status or to acquire a mate.

1. Introduction

A large body of evidence from finance suggests that individuals are atrocious stock market investors. They buy and sell the wrong stocks at the wrong time (e.g. Odean 1999; Barber & Odean 2001), under-diversify their holdings, (Barber & Odean 2001) and incur excess transaction costs by actively managing their stock portfolios, either on their own or through advisors (Stout 1995).

This bad stock market investing behavior costs individual investors a great deal of money. For example, using data from a large discount stock brokerage firm, Terrance Odean finds that if an individual sells shares of a company to buy shares of another company, on average, the return over the following year on the shares that she purchased will be 3.3 percentage points lower than the return on the shares that she sold (Odean 1999).[1] And this is before considering either management fees or commissions on the purchase and sale of the shares. One law and finance scholar put the total commissions and management fees paid in the U.S. in 1992 at over $100 billion, or about 1.8% of the market value of all U.S. equities (Stout 1995). Under-diversification can also be very expensive for some investors – a 2007 study based on the investment holdings of the entire Swedish population showed that, for the most under-diversified of investors, the cost of under-diversification was more than 5% of their financial wealth (Calvet et al. 2007). Under-diversified investors also lose because they tend to hold the wrong type of stocks – they prefer stocks that have a chance of a very large gain (so-called lottery-type stocks), and these types of stocks tend to greatly underperform the market (Bali et al. 2011).

Some groups of investors are more prone to making these investment mistakes than others. For example, single men earn worse stock market returns than married men, who in turn

[1] The author conjectures that this might occur because stocks that have had recent large price increases tend to be in the news and, thus, they attract the attention of individual investors. The high cost to individuals of short-selling means that far more of them buy these stocks than can sell them. Individuals sell other stocks to buy the newsworthy stocks, driving up the price of the newsworthy stocks above their intrinsic value. Some of these newsworthy stocks later revert to their intrinsic value and individual investors lose money (Odean 1999, p.19). Why arbitrage might not always work to prevent stocks exceeding their intrinsic value is discussed in section 2.3 of this chapter.

earn worse returns than women (Barber & Odean 2001). As well, less wealthy and less well-educated investors are more prone to making investment mistakes, and thus are more prone to earning lower stock market returns than their wealthier and more educated counterparts (Calvet et al. 2009; Anderson 2013).

That this bad stock market behavior persists in the face of evidence of its cost is perplexing to finance scholars. Given the wealth of information available to investors through the media and professional advisors, it ought to be easy for individual investors to avoid making the investment mistakes described above.[2] The rules that individual investors should follow if they wish to maximize their risk-adjusted returns are well-known and uncontroversial. The bedrock investment rule is the portfolio theory of stock market investing, which was first formalized by Markowitz (1952a). Since that time, variants of portfolio theory have been universally accepted by finance scholars and professionals as the preferred model for stock market investment (See for example Bodie et al. 2011). The gist of portfolio theory is that investors maximize their risk-adjusted returns by investing in a portfolio of stocks that is diversified by industry and geographically. The percentage of their assets that an investor ought to invest in stocks will depend on the degree of his or her risk aversion – the higher an investor's risk aversion, the lower the percentage of his or her wealth that the investor ought to invest in stocks (Bodie et al. 2011). However, the basic diversification strategy will apply regardless of investor risk aversion level. A concept that follows from portfolio theory is that, as individual investors generally do not have access to non-public information about individual stocks, they should not try to outperform the stock market through trading – such activity will increase transaction costs without increasing expected returns. Individual investors ought to buy and sell stocks only for liquidity reasons, for tax reasons or to rebalance their portfolio to match their risk aversion level (Bodie et al. 2011).

Economists assume that individuals invest in the stock market for the same reason that they engage in other forms of savings. They invest to temporally maximize their utility. They reduce their current consumption and invest the amount of the reduction in the stock market to

[2] In fact, there is evidence that investors who use financial advisers earn lower risk-adjusted returns than those who do not (Hackethal et al. 2012). There is also evidence that those with less financial literacy are less likely to seek out financial advice (Calcagno & Monticone 2015).

increase their consumption in the future.[3] But if this were the sole reason for individuals investing in the stock market, individuals would invest according to the tenets of portfolio theory, as that strategy has been shown to be the one that maximizes returns (and thus maximizes future consumption). The question that this chapter focuses on is: In the face of overwhelming evidence that diverging from portfolio theory is so costly, why don't individual investors invest according to the tenets of portfolio theory?

The prevailing view amongst economists and finance scholars is that individuals depart from portfolio theory because they lack relevant information or because they suffer from cognitive distortions. The hypothesis of this chapter is that many people invest in the stock market not only to maximize their expected return on investment, but also to (consciously or unconsciously) satisfy other (often more pressing) human needs, and that deviating from portfolio theory better satisfies those other needs. Accordingly, deviating from portfolio theory may even be a sensible strategy for some investors, rather than being solely due to cognitive distortions or to a lack of information.

This hypothesis is based on two recent lines of research relating to gambling. Firstly, a number of finance scholars have presented empirical evidence that investors who participate in gambling activities, such as buying lottery tickets, are more likely than non-gamblers to deviate from portfolio theory (See for example Kumar 2009). Secondly, recent research in psychology and evolutionary psychology suggests that people gamble to satisfy needs, rather than, as was previously thought, solely because they suffer from cognitive distortions (Binde 2013). The fact that gamblers are more likely than non-gamblers to deviate from portfolio theory suggests that people deviate from portfolio theory at least partly for the same reasons that they gamble. If they gamble in an attempt to satisfy certain needs, then they may also deviate from portfolio theory in an attempt to satisfy those same needs (Kumar et al. 2011).

What needs might investors be attempting to satisfy by deviating from portfolio theory? There is survey data and other evidence that individual investors deviate from portfolio theory because that manner of investing gives them the same form of enjoyment or entertainment as they get from gambling (Dorn & Sengmueller 2009). More interestingly, though, is that there is

[3]See (Samuelson 1958) for an early economics savings-consumption model.

also evidence that individual investors both gamble and deviate from portfolio theory to satisfy needs much more profound than entertainment (Binde 2013).

Using experiments and other sources of data, evolutionary psychologists show that young single men of low status take far more risk than others, and that they take these risks to obtain social status or to increase their chances of acquiring a mate, both of which are evolutionarily very important (Daly & Wilson 2001). Evolutionary psychologists have also shown that the same pattern applies to financial risk-taking. In a number of experiments, men (but not women) who are primed to compete for status or for mate acquisition take riskier financial decisions than when they are not so primed (Ermer et al. 2008). Accordingly, the evidence from finance that single men and people of lower social status deviate from portfolio theory more than other investors is consistent with an evolutionary psychology explanation for why investors deviate from portfolio theory (Kumar 2009). That is, some investors may deviate from portfolio theory in an attempt to satisfy evolutionarily important needs, such as the need for social status or the need to acquire a mate. There is also some evidence from evolutionary psychology that risk taking does indeed help men to achieve their goals of increasing status and acquiring a mate (Sylwester & Pawłowski 2011). It follows from this evidence that, even though deviating from portfolio theory reduces expected returns on investment, deviating may actually be a sensible strategy for status-seeking or mate-seeking investors.

That investors deviate from portfolio theory for reasons other than those associated with maximizing expected returns on investment is not a novel idea. The concept has been considered (and even modelled) in the economics literature and in recent finance literature (Barberis & Huang 2001; Barberis & Xiong 2009; Barberis & Xiong 2012; Fama & French 2007). However, the contribution of this chapter is to use an interdisciplinary approach (i.e. finance, psychology and evolutionary psychology) to attempt to explain the needs that individual investors might be trying to satisfy by deviating from portfolio theory.

In Part II, I show how individuals deviate from portfolio theory and how costly these deviations are to individual investors. In Part III, primarily using evolutionary psychology, I describe the needs individual investors may be attempting to satisfy by deviating from portfolio theory. Part IV concludes.

2. Suboptimal Investing – Nature of the Problem and its Cost

2.1. Stock Market Investing: Theory versus Practice

Modern portfolio theory assumes that investors are driven by only two factors – they like to earn expected returns on their portfolio but dislike variance of those returns. In 1952, Harry Markowitz constructed a model showing that an investor can reduce but not completely eliminate variance of returns by holding a portfolio of securities that have a low covariance of returns with one another (Markowitz 1952a). Relying on the assumptions that investors care only about expected return and return variance, William Sharpe and John Lintner each separately developed a model of capital asset pricing known as the Capital Asset Pricing Model ("CAPM"), and which has become the workhorse of modern finance (Sharpe 1964; Lintner 1965).[4] Under the CAPM, variance of expected return on a stock is driven by two types of risk: company-specific risk (also called idiosyncratic risk) and systematic risk. Company-specific risk is, by definition, uncorrelated to market prices in general, and can be eliminated by holding a large number of stocks.[5] Accordingly, that risk is not priced. Systematic risk of an asset can be thought of as the extent to which the price of that asset moves with movements in market prices in general – the more that the price of an asset moves with market price movements, the larger is the systematic risk.[6] The main inference of the CAPM is that the expected return on an asset is positively and linearly related to its systematic risk and that no other factor affects the expected return (Sharpe 1964; Lintner 1965). Based on the CAPM, an investor maximizes her risk-adjusted return by investing in some combination of a risk-free asset[7] and as widely diversified a portfolio of risky assets as possible (Lintner 1965, p.14).

[4] In their models, Sharpe and Lintner both assume that investors have homogeneous expectations and that investors can borrow and lend funds at the risk-free rate of interest. Sharpe recognizes the unrealistic nature of these assumptions (Sharpe 1964, p.434).

[5] By holding a very large number of stocks, an investor's variance of returns is minimized because negative company-specific shocks are likely to be balanced by positive company-specific shocks.

[6] For example, all stocks tend to do well in periods of strong economic growth and tend to do poorly in times of weak growth (Sharpe 1964, p.441).

[7] In the finance literature, long-term bonds issued by a government in its own currency are generally considered to be the risk-free asset. This is because a country that issues debt in its own currency will always be able to repay that debt. However, where a country is not permitted to print unlimited amounts of its own currency, such as countries that use the Euro, there is a default risk associated with government debt (Damodaran 2008).

While the CAPM continues to be the workhorse of finance, the relationship between risk and return implied by the CAPM has been very difficult to prove empirically.[8] Most studies show that the correlation between risk and return is positive but that the relationship is less monotonic and much flatter than the theory predicts (Subrahmanyam 2007) Two explanations have been given for the failure of the CAPM to predict expected stock returns. Richard Rolls suggests that the market portfolio is unknowable and, as a result, *"there is practically no possibility that . . . [a test of the CAPM] . . . can be accomplished in the future"* (Roll 1977, p.129).[9] The second explanation is that the CAPM fails because the assumptions on which it is based, such as the assumption that investors have homogeneous expectations of future returns and that arbitrage is cost-free, do not hold (Stout 1995; Fama & French 2004).

Even if the CAPM is flawed, there is little doubt that holding a diversified portfolio of stocks and minimizing trading is the strategy that individual investors ought to follow if their goal is to maximize their risk-adjusted expected returns.[10] To minimize company specific risk (and thus to maximize risk-adjusted returns), investors ought to hold a portfolio of stocks that is diversified across companies, industries and countries. As well, an investor ought not to trade stock except for liquidity reasons, for tax reasons or to rebalance her portfolio so that the risk profile of the portfolio matches her risk aversion level at any particular time (Bodie et al. 2011). For ease of reference, in the remainder of this chapter, I will use the term portfolio theory to mean any investment strategy that conforms to the concepts of wide diversification and limited trading.

A vast finance literature shows that individual investors regularly deviate from portfolio theory in a variety of ways.[11] These deviations may be usefully slotted into two categories – active portfolio management and under-diversification. Active portfolio management means that individual investors trade too much relative to the dictates of portfolio theory (Barber & Odean

[8] For a summary of the evidence against the CAPM, see Fama & French (2004) or Subrahmanyam (2007).

[9] In theory, the market portfolio would include all possible assets (including such things as human capital) and not just stocks (Fama & French 2004; Miller 1977).

[10] Many studies show that the portfolios of individual investors who hold a diversified portfolio and minimize trading perform best (For an overview of these studies, see Barber & Odean 2013).

[11] Deviations from portfolio theory are enumerated and extensively discussed in Barber & Odean (2013). For a discussion on how individual investors differ in their investment behavior from institutional investors, see Kumar et al. (2013).

2000).[12] Behavior that falls into the category of under-diversification include holding too few stocks,[13] holding stocks whose returns are highly correlated with one another (Goetzmann & Kumar 2008) and having a strong home bias.[14] As well, under-diversified individual investors prefer to hold stocks that exhibit the risk profile associated with lottery tickets; that is, they want stocks that have a low cost, a large chance of a small loss and a small chance of a large gain (Kumar 2009; Goetzmann & Kumar 2008). Alok Kumar finds that individual investors are more likely to hold lottery-type stocks than institutional investors and that less wealthy individual investors are more likely to hold lottery-type stocks than wealthier individuals (Kumar 2009).

The essence of the under-diversification problem is that under-diversified investors take on risk for which they are not compensated. An under-diversified investor could reduce the riskiness of his portfolio without reducing his expected return simply by spreading his investment over a greater number of stock holdings (Bodie et al. 2011). Note that an investor could hold a very risky portfolio and still comply with portfolio theory. For example, an investor who had $10,000 to invest could, in theory, borrow $30,000 and invest the full $40,000 in a very broad-based basket of stocks. This would certainly be a risky strategy since a 25% decline in stock prices would wipe out the investor. However, this strategy would be fully in keeping with portfolio theory since the investor would be employing a diversified buy and hold strategy. Accordingly, a risk-seeking investor need not deviate from portfolio theory to satisfy her desire for risk. However, the preference for lottery-type stocks suggests that individual investors do not want just any risk; they want stocks that have a risk profile which includes the possibility of a very big win.

[12]Using a large data set from a U.S. discount broker, Barber & Odean find that the average portfolio turnover rate is 75% per year (far more than seems necessary for liquidity, tax or rebalancing purposes). Even where investors choose to delegate their stock trading activity by investing through actively managed mutual funds, they trade the mutual funds more than seems optimal. Lynn Stout calculated that the rate of turnover of mutual fund holdings was 26% in 1991 (Stout 1995)

[13] Barber & Odean (2000) find that the average number of stocks held by individual investors was 4. Goetzmann & Kumar (2008) find that between 1991 and 1996, the average number of stocks went from 4 to 7. Both studies find that individual investors tended to hold more volatile stocks (with positive skewness) than the market.

[14] An investor who has a home bias invests primarily in stocks of companies headquartered in the country of residence of the investor (See Strong & Xu 2003 for the proposition that individual investors tend to invest overwhelmingly in stocks of companies in their home country; See French & Poterba 1991 for the proposition that the percentage of investors' portfolios dedicated to foreign stocks has increased over time; See French 2008 for the proposition that investors who trade excessively also tend to buy local stocks; also see Goetzmann & Kumar 2008).

2.2. Bad Investment Behaviour is Costly

Active management and excess trading is very costly to investors. Kenneth French puts the overall cost of active investing in the United States in 2006 at $106 billion, or $330 per American (French 2008). In a U.S. study of 1992 active investing costs, Lynn Stout calculated costs of over $100 billion dollars (Stout 1995) A Taiwanese study found that individual investors lose a staggering 3.8 percentage points of investment return each year because of excess trading (Barber et al. 2006) Two-thirds of the loss is attributable to unnecessary trading commissions and transaction taxes and the remaining one-third is attributable to the fact that shares that individual investors sell perform better than the shares that they buy (Barber et al. 2006) A recent Swedish study found that investors who are frequent traders perform more poorly than passive investors (Anderson 2013) Mirroring the Taiwanese study, they find that two-thirds of the underperformance is attributable to unnecessary transaction costs and one-third is attributable to "*stock selection or timing*" (Anderson 2013, p.4) The study also shows that less educated and less wealthy investors bear a much higher proportion of trading losses than other investors, relative to the value of their stock portfolios.[15]

The cost of under-diversification is more difficult to quantify. Under-diversification reduces the risk-adjusted returns to investors, but, for most investors, this is not nearly as costly as active management (Calvet et al. 2007). However, for some investors, under-diversification has been shown to be very costly. For example, the evidence in a study of Swedish households is that 5% of the population lose more than 5% of their financial wealth because they are under-diversified (Calvet et al. 2007). Goetzman and Kumar (2008) find that, adjusted for risk, the least diversified group of investors underperforms the most diversified group by 2.4 percentage points. Large losses associated with under-diversification have also been identified for individuals who invest their self-directed pension plans in company stock (Meulbroek 2005).

Another cost associated with under-diversification relates to the fact that under-diversified individual investors prefer to hold lottery-type stocks. A preference on the part of some investors for lottery-type stocks may increase the price (and thus reduce the expected returns) of those stocks to below what the CAPM predicts. Accordingly, undiversified individual investors not only take on risk for which they are not fully compensated, they further reduce their

[15] Investors who did not have a university degree and who were among the 40% least wealthy in the country owned 3% of total financial wealth but bore 27% of the trading losses (Anderson 2013, p.5).

expected return by buying overpriced lottery-type stocks. Kumar finds that the return on lottery-type stocks is almost 8% lower than on non-lottery-type stocks (Kumar 2009). As lottery-type stocks are held disproportionately by less sophisticated and less wealthy individuals, those investors bear a high proportion of this cost relative to the size of their stock portfolios. In the remainder of this Part, I review the finance literature which empirically shows that lottery-type stocks are overpriced and explain how lottery-type stock overpricing could persist. The discussion is somewhat technical, although I expect that even those without a finance background can follow it. However, readers can skip ahead to Part III without losing the thread of the chapter.

2.3. Overpricing of Lottery-type Stocks

Andrew Ang *et al.* find that stocks with high idiosyncratic volatility[16] at a given point in time tend to have low future returns relative to the stock market as a whole (Ang et al. 2006). Stocks in the top quintile of idiosyncratic volatility underperform stocks in the bottom quintile of idiosyncratic volatility by about 1% per month (Ang et al. 2006, p.261). This is contrary to what theory suggests, which is that there ought to be no correlation between the idiosyncratic volatility and expected returns. Recent studies have also purported to show that the returns on stocks predominantly held by individual investors (which tend to be stocks exhibiting high price volatility) do not increase with the volatility of the stock price. In fact, in some studies, the returns on such stocks has been shown to decrease with the level of idiosyncratic volatility. This seemingly perverse risk-return relationship has been observed in recent U.S., Dutch and German studies (Goetzmann & Kumar 2008; Hoffmann & Shefrin 2014; Meyer & Schroff 2013, respectively). However, Bali *et al.* (2011) show that if the preference for holding stocks that exhibit an extreme positive return (i.e. lottery-type stocks) is taken into account, this result reverses and returns on such stocks increase slightly with the level of idiosyncratic volatility.[17] This finding is consistent with Kumar, who finds that the average annual risk-adjusted return for portfolios held by individual investors is 1.1 percentage points less than the return on a market

[16] Idiosyncratic volatility is stock price volatility that is not correlated with the market, but that results from company-specific risks. See section 2.1 of this chapter for a discussion of company-specific risk versus market risk.

[17] This relationship between positive skewness and expected returns is not observed for shares held primarily by institutional rather than individual investors (Chichernea et al. 2014; Also see Han & Kumar 2013)

portfolio and that this underperformance increases as the percentage of lottery-type stocks in the portfolio increases (Kumar 2009). This research suggests that it is the preference for positive skewness that is priced, not a more abstract preference for risk.

Shares of companies that have gone into financial distress are an example of lottery-type stocks. Campbell *et al.* find that shares of financially distressed companies have higher than average systematic volatility (Campbell et al. 2008). The CAPM predicts, therefore, that such shares ought to have higher than average returns. However, Campbell *et al.* (2008) find that shares of distressed companies have lower than market returns. Kauser *et al.* (2013) posit that the reason why shares of distressed companies underperform is that their price is driven up by investors because of their "*lottery-type*" attributes. They attribute the underperformance to "*gambling-motivated"* trading behavior of individual investors (Kausar et al. 2013). Shares of companies that are in financial distress fit the profile of lottery-type stocks because they have a very low price, there is a large chance of the shares becoming worthless and a small chance of a very large return if the company is able to become viable. A recent example is the shares of American Airlines. American Airlines went bankrupt in November 2011 and its shares traded as low as $0.20 in that month. However, by April 2014, the price had increased to $27 – 135 times the price in November 2011.[18] In almost all bankruptcy cases, shareholders lose virtually all their investment, but in this particular case the shareholders got a very big win.

At the heart of the CAPM is the assumption that investors need to be compensated for taking on risk – the higher the systematic risk of a stock, the more expected return that an investor will demand in order to hold that stock (Markowitz 1952a; Sharpe 1964; Lintner 1965). It has been assumed in the literature that the compensation for taking on risk is always in the form of higher expected return. However, the compensation could be partly in a form other than expected returns on investment – for example, it might just be in the form of the enjoyment that some investors receive from investing in the stock market.[19] The compensation that is in a form other than expected returns on investment would be difficult to measure and may be greater for certain types of stock, such as lottery-type stocks. If investors obtain greater enjoyment from holding lottery-type stocks than from holding other stocks, they may be prepared to pay more for

[18] http://online.wsj.com/news/articles/SB10001424052702303456104579489282879045884

[19] See discussion in Part III.A.

those stock (in other words, they might be willing to accept a lower expected return) than the price predicted by the CAPM.[20] This preference on the part of individual investors might be what causes the expected return on those stocks to be less (and the price to be higher) than the CAPM predicts (Barberis & Huang 2008).

In theory, if the preferences of individual investors cause certain stocks to exhibit a lower level of expected return than the CAPM predicts, arbitrageurs would short sell that stock until the expected return on that stock equals the expected return predicted by the CAPM. In practice, though, arbitrage may be difficult to accomplish and, in any event, it will not be costless.[21] Arbitrageurs need to borrow stock (which may be difficult, particularly for stock of smaller companies) in order to short sell it (Baker & Wurgler 2006). If the individual investor sentiment for a stock is strong, arbitrageurs may need to hold a large undiversified short position in that stock for an extended period of time (Baker & Wurgler 2006). This is a risky proposition and arbitrageurs would have to balance that risk against their expected profit on the short position. Accordingly, arbitrageurs may be unwilling to short certain stocks, with the result that the low expected return may persist (Shleifer & Vishny 1997).[22] It is even possible that a superior strategy for professional traders is to buy stocks that they believe are overpriced, with the expectation that individual investors will bid up the prices of those stocks even further (Blanc & Rachlinski 2005).

3. Using Evolution to Explain Deviations from Portfolio Theory

Under-diversification and active portfolio management are difficult to explain using traditional finance or economics models (Subrahmanyam 2007). Under economic theory, investing in the stock market is a form of savings; that is, as with other forms of savings, by investing in the stock markets, individuals reduce their current consumption in order to fund

[20] This analysis is similar to that employed by (Brunnermeier et al. 2007). They suggest that individual investors obtain utility from choosing to hold optimistic beliefs about future outcomes, and that they design their investment portfolios in such a way as to maximize the sum of the optimistic beliefs utility and the utility that they obtain from earning high returns on their investments.

[21] For an extensive discussion on the difficulties that arbitrageurs face, see (Barberis & Thaler 2003).

[22] For additional literature on the difficulty of arbitrage, see (Bali et al. 2011, p.444). Fama & French (2007) show mathematically that if some investors obtain utility from holding stock that is unrelated to the expected return on that stock, the price of that stock will remain higher than what the CAPM predicts, even if arbitrageurs are active.

future consumption.[23] If, as the traditional finance and economics models assume, the sole reason for investing in the stock market is to shift consumption into the future, rational individual investors would invest according to portfolio theory because that investing style has been shown to maximize risk-adjusted expected returns (and hence to maximize the expected amount available for future consumption).[24] Accordingly, in the face of the overwhelming evidence that individual investors deviate substantially from portfolio theory and that such deviations are costly, individual investors who deviate from portfolio theory must either (i) be acting irrationally (that is, in a way that does not maximize their utility) or (ii) be attempting to satisfy needs that can be better satisfied by investing in a manner that deviates from portfolio theory.[25]

Over the last 30 years or so, many finance scholars have adopted concepts developed by behavioral economists to explain why investors deviate from portfolio theory (e.g. Subrahmanyam 2007). A common behavioral explanation is that individual investors trade excessively and under-diversify because they are overconfident in their own stock picking abilities.[26] Another common explanation is that investors base their decisions to buy and sell stocks on recent price movement using the so-called availability heuristic.[27] Excess trading and under-diversification may also be aggravated by the disposition effect; investors sell their winning stocks and keep their losers, rather than simply keeping both winners and losers (Odean 1998). The behavioral analysis assumes that under-diversification and excessive trading are irrational and that, with the right incentives and information, investors will change their behavior (Subrahmanyam 2007).[28]

[23] This theory relies on the economics concept of declining marginal utility. Rather than spending all their income as they earn it, individuals prefer to consume evenly over time. Accordingly, they will save in their high income years and use that savings to consume more in low income years (Samuelson 1958).

[24] Or, alternatively, to minimize the amount of current consumption they need to give up to attain a certain level of future consumption.

[25] I suggest that, to know whether a particular behavior is rational, we need to know the objective that the investor is attempting to reach. See for example (Sugden 2008).

[26] For a discussion of overconfidence and under-diversification, see Goetzmann & Kumar (2008).

[27]Under the availability heuristic, individual investors base their investment decisions on readily available information, such as recent stock price movements or recent news items (Goetzmann & Kumar 2008).

[28]The irrationality of this type of behavior was first discussed by (Kahneman & Tversky 1979).

There is a great deal of empirical literature supporting both the behavioral effects discussed in the previous paragraph and the proposition that those behavioral effects reduce investors' expected returns.[29] However, there is also evidence that factors such as overconfidence may not be the main reason for why people deviate from portfolio theory. In a study using trading data and an investor survey, Daniel Dorn and Gur Huberman show that self-reported overconfidence does not explain the degree of diversification or of trading (Dorn & Huberman 2005). Experiments have been conducted that only weakly support the proposition that people who are overconfident trade more (Deaves et al. 2008; Glaser & Weber 2007) and have poorer performance (Biais et al. 2005). Mark Grinblatt and Matti Keloharju show that sensation seeking and overconfidence both contribute to excess trading, but that sensation seeking is the more explanatory of the two variables (Grinblatt & Keloharju 2000). There appears to be even less of a link between overconfidence and under-diversification. Alok Kumar finds that the propensity to under-diversify is negatively correlated with measures of overconfidence (Kumar 2009; also see Kausar et al. 2013). Accordingly, in the face of this often conflicting empirical evidence of the role that overconfidence plays, it is worth considering other potential explanations for why individual investors deviate from portfolio theory.

The hypothesis of this chapter is that individual investors deviate from portfolio theory to (consciously or unconsciously) satisfy needs that they could not satisfy if they invested according to portfolio theory. I defer until later a discussion of what needs investors may be attempting to satisfy by deviating from portfolio theory. However, I do assume that the needs that investing in the stock market satisfy, other than those associated with maximizing expected returns, are all forms of current consumption.

Earlier in this Part, I introduced the concept of savings as a mechanism for temporally maximizing utility. I also suggested that that mechanism applied equally to stock market investing; that is, by investing in the stock market, people decrease their current consumption to increase their future consumption. However, the analysis changes somewhat if individuals invest in the stock market partly for current consumption.

Investor decisions regarding the extent to which they follow or deviate from portfolio theory can be thought of as attempts to further temporally maximize utility by balancing current

[29] For a recent summary and analysis of this literature, see Barber & Odean (2013).

consumption against future consumption. By deviating from portfolio theory, investors give up some future consumption (because they earn lower stock market returns) in order to derive current consumption. In theory, an investor who derives current consumption by investing contrary to portfolio theory could achieve a similar mix of current versus future consumption by (i) reducing the amount that he invests in the stock market but investing according to the tenets of portfolio theory and (ii) spending the amount of the investment reduction on goods or services that give the investor the same type of current consumption that he would have derived if he had deviated from portfolio theory. To determine whether to follow or to deviate from portfolio theory, the investor would need to compare the utility that he derives under each of those strategies. It is conceivable that an investor who makes this calculation (explicitly or implicitly) would decide that deviating from portfolio theory is a utility maximizing strategy, even though it is not a strategy that maximizes expected returns on investment.

It follows from this hypothesis that, even if individual investors could be convinced that their stock market investing behavior was costing them in terms of reduced future consumption, they would continue to trade excessively and under-diversify so long as the utility that they derive from investing in that manner was greater than the utility that they would derive by investing according to portfolio theory.

There is evidence that individual investors do enjoy investing in the stock market in a manner that deviates from portfolio theory, and that they do not derive that same enjoyment by following portfolio theory. In a comprehensive U.S. survey of investors who held accounts at a full-service broker, respondents reacted more positively to the following statements regarding their attitudes towards investing than any other of the proffered statements: "*I enjoy investing and look forward to more such activity in the future*" and "*relying exclusively on mutual funds reduces the personal satisfaction I obtain from making my own investments*."[30]

In a study of German investors which matched survey responses to trading records from a discount broker, those who responded positively to the question of whether they enjoyed investing traded much more than those who responded negatively to that question (Dorn & Sengmueller 2009). Similar results were found in a Dutch study matching survey results to

[30] They rated those statements at 4.09 and 3.94, respectively, with 5 being the most positive response (Lease et al. 1974).

trading records (Hoffmann & Shefrin 2008). Nicholas Barberis and Ming Xiong suggest that the disposition effect (i.e. investors sell their winners and keep losers) is caused by what they call "realization utility"; that is, investors enjoy the feelings associated with selling winners and are averse to the feelings associated with selling losers (Barberis & Xiong 2012). A subsequent experiment tested the realization utility theory by taking images of participants' brains using functional magnetic resonance imaging while those participants were engaged in a simulated trading game. The results were that when issuing sell orders on winning stocks, participants experience a sharp rise in activity in the part of the brain associated with feelings of pleasure (Frydman et al. 2014).

While these studies are evidence that some people deviate from portfolio theory because it gives them a form of current consumption (i.e. enjoyment or entertainment), the studies do not consider whether investors consider the very substantial cost of deviating from portfolio theory. Accordingly, these studies do not answer the question of whether investor deviations from portfolio theory are rational since investors might not be aware that their investment behavior is significantly reducing their return on investment.

Nor do the studies deal with the question of what it is about deviating from portfolio theory that investors enjoy. Do they enjoy deviating from portfolio theory simply because that manner of investing is entertaining, in the same way that watching a movie is entertaining? Or does the enjoyment come about because deviating from portfolio theory satisfies more profound needs? I make the case below that individuals may be deviating from portfolio theory invest to satisfy evolutionarily important needs, such as the need for status and the need to find a mate. The building blocks of my case are (i) recent finance literature which finds that investors who deviate from portfolio theory are also prone to engaging in gambling and other risky behavior and (ii) recent psychology and evolutionary psychology literature which finds that people may gamble and engage in other risky behavior to satisfy evolutionarily important needs. I will expand on those building blocks below, after which I will develop an evolutionary framework for why individuals deviate from portfolio theory.

3.1. Stock Market Investment as Gambling: The Evidence

From the earliest days of portfolio theory, it has been mooted that some people deviate from portfolio theory because they like to gamble.[31] It may seem intuitive that people who participate in the stock market by under-diversifying or through excess trading may also be the same people who like to gamble. However, it is only recently that the link between stock market investment behavior and gambling propensity has been empirically tested.[32] While this literature is still in a nascent stage, the link between investment behavior and gambling is compelling.

Using account data (including stockholdings, trading and demographic information) from a discount brokerage firm, Kumar finds that individual investors who under-diversify prefer to invest in lottery-type stocks, which Kumar defines as stocks that have attributes associated with lottery tickets. As mentioned earlier, these attributes include a low price, a large chance of a small loss and a small chance of a large gain. Stocks that have a high positive skewness of returns (Kumar et al. 2011) or "*that exhibit an extreme positive return*" (Bali et al. 2011; Mitton 2007) have these attributes. A desire to hold lottery-type stocks would tend to result in under-diversification since diversification would reduce the chance of a truly big win. Suppose that an individual investor has a preference for a small chance of an extreme positive return and that the only two stocks that are available to him each have a 1% chance of a tenfold increase in price. Also assume that the return on one stock is independent of the return on the other. If the investor holds one stock, he has a 1% chance of a tenfold return. If he holds both stocks he has only a 0.01% chance of a tenfold return.[33] If the investor's objective is to maximize his chances of earning the extreme tenfold return, he will buy just one of the two stocks. This concept may be generalized to the real world of investing. The more stocks an investor owns, the more likely it is that he will earn a market return rather than a return that is much higher (or lower) than the market return.

Kumar (2009) finds empirically that those investors who fit the profile of lottery ticket buyers (such as young single men) are more likely to both under-diversify and to buy lottery-

[31] In fact, Markowitz himself suggests that stock market speculation is "gambling". He posited that some people may like to buy stocks that have a small chance of a large gain (Markowitz 1952b).

[32] Kumar (2009) was the first to empirically test the link between gambling and stock market investing.

[33] Since the returns on each stock are assumed to be independent of each other, the chance of getting a tenfold return by holding both stocks is 1% multiplied by 1%.

type stocks. He also finds that those of low relative status – those relatively poorer than their neighbours – buy both more lottery tickets and more lottery-type stocks Based on an analysis of the U.S. Consumer Expenditure Survey, Geng Li also finds that people who gamble are more active in stock markets (Li 2012). The implication of this research is that an investor's propensity to gamble somehow affects his or her stock market investing behavior.

Recent empirical studies find that stock trading substitutes for lottery ticket purchases in the U.S., in Germany and in Taiwan – individual investors trade less during periods where the national lottery jackpot is high (Dorn et al. 2014; Gao & Lin 2014). This effect is greater for male and less educated investors and in the trading of lottery-type stocks (Dorn et al. 2014). Kumar (2009) also finds that, like the demand for lottery tickets, the demand for lottery-type stocks increases in bad economic times. A Swedish study used trading records and tax records to find that those who hold under-diversified portfolios also trade excessively, and that those who engage in that behavior tend to have lower income, wealth, age and education (attributes that are associated with lottery ticket buyers) (Anderson 2013). Lucasz Weber and Elke Markiewicz recruited participants into a simulated investment game and, at the end of the game, had participants complete a DOSPERT (a measure of gambling propensity) survey (Markiewicz & Weber 2013). They found that *"gambling risk-taking propensity predicts trading volume"*. Mark Grinblatt and Matti Keloharju used Finnish investor tax filings, driving records and psychological tests given to military recruits to find that excess trading is driven by both sensation seeking (measured in the number of speeding tickets) and by overconfidence (measured by psychological tests administered by the military) (Grinblatt & Keloharju 2009). These studies are all consistent with the proposition that stock trading substitutes for forms of gambling, such as lotteries.

As discussed in Part II.C., the empirical evidence is that the expected returns on lottery-type stocks is lower than on non-lottery-type stocks (Bali et al. 2011; Barberis & Huang 2008). Accordingly, investors who are only interested in maximizing their expected returns ought not to buy lottery-type stocks. The fact that individual investors do buy lottery-type stocks might just mean that they fail to understand that the expected return on those shares is lower than the expected return on non-lottery-type stocks. Experiments have shown that people do misunderstand probabilities in many gambling situations, but there is also evidence that people gamble even when they understand the probabilities. In a 2006 Canadian study, students were

given specialized instruction on the statistics of gambling. Six months after the end of the instruction, those same students were tested on their ability to calculate gambling odds, and were found to be better able to calculate those odds than before the instruction. However, the study also found that those students were no more likely to decrease their gambling behavior than students in the control group (Williams & Connelly 2006). In addition, a number of studies involving pathological gamblers also find that there is little or no correlation between numerical reasoning skills and gambling behavior (Lambos & Delfabbro 2007). These studies suggest that gambling is not due to a simple misconception of the relationship between risks and return. The studies support the proposition that people engage in gambling behaviour because they derive utility from it. To the extent that individual investors deviate from portfolio theory to satisfy the same needs that gambling satisfies, these studies also support the proposition that individual investors derive utility from deviating from portfolio theory.

Additional support for the proposition that individual investors know what they are doing when they deviate from portfolio theory is found in Dorn & Huberman (2005). They use German brokerage account data and survey data to find that individual investors who self-report being less risk averse hold less diversified portfolios and trade much more often. As well, in a U.S. study matching survey data with brokerage account data, those who said they were willing to take more risk held fewer stocks (Polkovnichenko 2005). These studies suggest that investors are not unaware of the level of risk that they are taking on by deviating from portfolio theory.

In summary, there is mounting evidence that people who have more of a propensity to gamble deviate from portfolio theory more than those who have less of a propensity to gamble. There is also evidence that stock market investing is a substitute for gambling activity and that people are aware that they are taking on additional risk when they deviate from portfolio theory. The finding of a link between propensity to gamble and propensity to deviate from portfolio theory suggests that people deviate from portfolio theory for the same reasons that they gamble. Accordingly, if people gamble to satisfy certain needs, we may be able to infer that people also deviate from portfolio theory to satisfy those same needs.

3.2. Gambling (and Deviating from Portfolio Theory) to Satisfy Needs

The analysis in this Part draws on research from the fields of economics and psychology into why people gamble. I first review the prevailing views in economics and psychology that people gamble because they suffer from cognitive distortions. I then review (i) more recent theories in economics that people obtain utility from gambling and (ii) theories in psychology that people engage in leisure gambling to fulfil certain needs. I follow with a summary of the tenets of evolutionary psychology, which I believe offers some promising reasons for why and under what circumstances people engage in risky behavior, such as deviating from portfolio theory.[34]

Research in the field of psychology into why people gamble has only been rigorously conducted during the last 30 years and has generally been limited to studying the motivations of problem gamblers (Fortune & Goodie 2012).[35] Much of this research has focussed on whether problem gambling is associated with various cognitive distortions (Fortune & Goodie 2012). Even less is known about what motivates leisure gamblers – that research is in a nascent stage.[36] However, the results of the limited research into leisure gambling suggests that leisure gamblers may not suffer from the same cognitive disorders as do problem gamblers (Fortune & Goodie 2012). As well, leisure may have different personality traits than problem gamblers (Goodie 2005).[37] As the motivations and personalities of leisure gamblers may differ substantially from those of problem gamblers, it is not clear how relevant the research into problem gambling is to leisure gambling (Fortune & Goodie 2012; Binde 2013).

The prevailing view in economics is that people gamble because of cognitive distortions (Kahneman & Tversky 1979; Von Neumann & Morgenstern 1953). However, as discussed

[34] The use of biological behavioral science, such as evolutionary psychology, in the study of law is recent but growing. For an overview of the field of Law and Behavioral Biology, see (Jones & Goldsmith 2005). For a discussion on how principles of evolution may be incorporated into the field of economics, see (Gandolfi et al. 2002).

[35] The psychology literature uses the terms "pathological gambler" and "problem gambler". A problem gambler is someone who is or is at risk of becoming a pathological gambler (Jacobsen et al. 2007).

[36] See Binde (2013) for a discussion on what motivates leisure gamblers. I use the terms non-problem gambler and leisure gambler interchangeably. There appears to have been a belief among some academics that the study of leisure gambling was a "taboo" subject in the academic world – see (Thompson & Potts 2011). The finding of that paper, based on empirical evidence, is that gamblers are happier than non-gamblers. The likely relationship is that happy people tend to gamble more than unhappy people, rather than gambling causing happiness.

[37] For example, leisure gamblers are less confident and more risk averse than problem gamblers.

below, recent scholarship attempts to fit the desire to gamble into the theory of expected utility maximization.

3.2.1. Cognitive Distortions

Greatly influenced by Amos Tversky and Danial Kahneman, the prevailing wisdom in both psychology and economics is that cognitive distortions play a leading role in gambling (Fortune & Goodie 2012). Kahneman and Tversky are also the founders of the field of behavioral economics, which is the branch of economics most closely associated with the study of decision making under conditions of uncertainty. Unsurprisingly then, in both psychology and contemporary economics, much of the research into gambling has to do with identifying the cognitive disorders which lead people to gamble and (particularly in psychology) considering ways in which such cognitive disorders may be corrected.

Kahneman and Tversky suggest that in making decisions under uncertainty, people do not seem to calculate the odds or to rely on statistical analysis. Rather, they appear to rely on heuristics, and it is the reliance on these heuristics which sometimes leads people to make systematic errors or biased judgements (Kahneman & Tversky 1973). The cognitive distortions that gamblers (or, at least, gamblers who are pathological gamblers) suffer from are thought to be caused by the biases from using the heuristics identified by Kahneman and Tversky (Fortune & Goodie 2012).

Fortune & Goodie (2012) catalogue the common gambling-related cognitive distortions and associate them with the heuristics identified by Kahneman and Tversky. For example, they observe that pathological gamblers believe that they can influence the outcome of random events and they suggest that this cognitive distortion is based on the availability heuristic.[38] Pathological gamblers also believe that there are correlations between independent events such as the outcome of a toss of a coin – if heads comes up, say, 4 times in a row, they believe that the odds of tails coming up in the next toss is more than 50% (Jacobsen et al. 2007; Fortune & Goodie 2012). This latter distortion, often referred to as "gamblers fallacy" is very prominent in pathological gamblers and is thought to be a distortion derived from the representative heuristic (Jacobsen et

[38] Known in the psychology literature as the illusion of control (Fortune & Goodie 2012).

al. 2007; Fortune & Goodie 2012). Pathological gamblers also tend to be overconfident due to using the representative heuristics (Fortune & Goodie 2012). The availability heuristic is thought to be the reason for the observed phenomenon of big wins early in a person's gambling experience making it more likely that the person will become a pathological gambler – the early wins contribute to an expectation of winning in the mind of the person (Jacobsen et al. 2007).[39] Pathological gamblers also believe that their chances of success are *"higher than the objective probability should warrant"* (Fortune & Goodie 2012, p.301). Note the similarity between the cognitive distortions that appear to motivate pathological gamblers and the cognitive distortions which have been identified in the field of behavioral finance which cause investors to deviate from portfolio theory (see introduction to Part III).

More than 80% of people in many western countries have gambled at some point in their lives (Young & Stevens 2009). However, only a small percentage of the population have ever become pathological or problem gamblers (Shaffer et al. 1999).[40] Some of the cognitive distortions identified in the previous paragraph have been shown not to apply, or to apply to a much lesser extent to leisure gamblers. For example, leisure gamblers appear to be less overconfident and less prone to the illusion of control than are problem gamblers (Goodie 2005). Leisure gamblers are also less subject to gambler's fallacy and to seeing illusory patterns (Wilke et al. 2014). As well, pathological gamblers have been found to be more certain than leisure gamblers of their erroneous perceptions (Jacobsen et al. 2007; Cote et al. 2003). Lambos and Delfabbro (2007) find that pathological gamblers make more cognitive mistakes than leisure gamblers. Leisure gamblers have also been found to be less impulsive than pathological gamblers (Breen & Zuckerman 1999). Accordingly, it does not follow from the research into problem gambling that cognitive distortions are a primary motivation for the vast bulk of gamblers. Rather, leisure gamblers may gamble to fulfil certain needs.

[39] Compare that finding to (Kaustia & Knupfer 2008), in which the researchers find that people who do well in the first IPO that they buy into are much more likely to buy into another IPO than those who do not do well on the first one.

[40] They find that the lifetime adult prevalence for pathological gambling is around 1.5% and the lifetime adult prevalence for problem gambling is around 3.85%.

3.2.2. Gambling as Needs Fulfilment

3.2.2.1. Views of Economists

Economists have struggled to explain the prevalence of gambling. The accepted view is that, in a world with decreasing marginal utility of income, rational actors would never accept a fair bet because the gain in utility of a win would be less than the loss of utility in the case of a loss (Marshall 1890). In their treatise of 1953, John von Neumann and Oskar Morgenstern formalized the concept of decreasing marginal utility of income into several axioms.[41] Von Neumann and Morgenstern were certainly aware that gambling was problematic for their model. They ask in their treatise: *"May there not exist in an individual a (positive or negative) utility of the mere act of "taking a chance," of gambling, which the use of the mathematical expectation obliterates?"* (Von Neumann & Morgenstern 1953, p.28). They quickly answered this question in the negative on the grounds that such a utility would contradict the axioms they formulate in their treatise.[42] More recently, Paul Samuelson stated that gambling involves only transfers of money, "creating no new money or goods" (Samuelson 1947).

Marschak (1950) gave the following example of a situation in which one might reasonably be said to gain utility from a risky activity: A mountain climber might prefer to climb a mountain that has a 95% survival rate than climbing either (i) a mountain that has an 80% survival rate or (ii) a mountain that has a 100% survival rate. However, this preference set is not recognized by an expected utility model since it violates the axiom of monotonicity (Marschak 1950). Marschak suggests that revising the concept of rational choice to reflect *"the love of danger"* would make it impossible to attain *"manageable utility indices"* (Marschak 1950, p.139). John Harsanyi and others have suggested that utility theory excludes gambling utility because any utility associated with gambling has to do with the process of gambling and not with the consequences of gambling (discussed in Le Menestrel 2001). In summary, while some of the leading early thinkers on utility theory acknowledged that it is possible that individuals may

[41] The axioms include transitivity, completeness, stochastic dominance and monotonicity (Von Neumann & Morgenstern 1953)

[42] "*Thus a suitable definition of utility (which in such a situation is essentially uniquely determined by our axioms) eliminates in this case the specific utility or disutility of gambling, which prima facie appeared to exist*" (Von Neumann & Morgenstern 1953, p.629).

obtain utility from gambling, they could not fit gambling utility into a rational expectations model and, accordingly, they chose to ignore any concept of gambling utility in their models.

An early attempt to explain gambling within expected utility theory was provided by Milton Friedman and L.J. Savage (Friedman & Savage 1948). They developed a utility function to explain why individuals might be risk seeking regarding certain decisions and risk averse regarding other decisions. The neo-classical utility function that describes the marginal utility of money is concave throughout. In contrast, the utility function Friedman and Savage develop is concave in some parts and convex in others.[43] The implication of such a function is that for some decisions, the expected utility associated with the good outcome of a gamble outweighs the expected loss in utility associated with the bad outcome of that gamble, even though the expected money gain is less than the expected money loss. For example, a person in a low socio-economic class may buy a lottery ticket because the benefit of a win is very large (he moves to a higher socio-economic class) and the cost of losing is very low (the cost of a lottery ticket may have almost no impact on his standard of living). Accordingly, the individual may buy a lottery ticket even if the expected return on the ticket is decidedly negative. This utility function also explains why an individual who gambles also buys insurance. Paying an insurance premium may have little effect on an individual's standard of living, but an uninsured loss may cause the individual to lose socio-economic status (Friedman & Savage 1948).

More recently, researchers have developed models to explain gambling that maintain the traditional concavity of utility functions. John Conlisk developed a model in which there is a separate utility to the process of gambling that is not captured by the income utility function and once this separate utility is taken into account, gambling fits within the diminishing marginal returns to income model (Conlisk 1993). This separate utility has to do with the suspense and excitement of the process of gambling. Marc Le Menestrel maintains the axioms of the neo-classical expected utility function but suggests that individuals may also be motivated by the process of gambling and, accordingly, *that "a rational individual" . . . [will take into account] . . . "a preferred process and a preferred consequence"* (Le Menestrel 2001, p.251). John Nyman *et al.* suggest that gambling fits within the traditional concave utility function once you take into account the fact that individuals who gain gambling winnings get an additional benefit that they

[43] For a diagram of the function, see Friedman & Savage (1948), at p. 295. It bears a resemblance to the kinked value function developed by Kahneman and Tversky (Kahneman & Tversky 1979).

do not get from labor income, namely that they do not have to work for the gambling winnings – gambling income thus commands a premium over labour income (Nyman et al. 2008; Nyman et al. 2013).

While none of these theories have gained wide acceptance among economists, they show an increased understanding that neo-classical expected utility theory ought to be able to account for the observed facts that people derive some form of utility from gambling (Diecidue 2004). While economists have generally understood that people may derive utility from gambling, that utility is not the type of utility that can be modelled and, accordingly, it has been ignored.

3.2.2.2. Views of Psychologists

Because research into the psychology of gambling started relatively recently, it is almost exclusively studied through the lens of cognitive distortions and personality variables, which are the psychological disciplines that prevailed throughout the entire period that the subject has been studied (Jacobsen et al. 2007). However, recent scholarship has started to consider biological, social and evolutionary reasons for why people gamble. Some of this research suggests that people engage in leisure gambling not only due to cognitive distortions but also to satisfy certain human needs, such as the need to garner social rewards or to experience the pleasurable anticipation of a potential reward (Binde 2009).

Per Binde recently developed a theory that while *"a chance of winning"* is common to all forms of gambling, it is not the real motive for leisure gambling – *". . . pure money is the medium of gambling, not what gambling actually is about"* (Binde 2009, p.83). The possibility of gain through gambling induces feelings of pleasure and satisfaction. Studies show that winning can trigger certain neurochemical processes in the brains of humans and animals – the positive feelings associated with being rewarded for taking risk may thus be the result of natural selection. As well, since human societies are built on the concept of reciprocity, receiving more than one pays in a gambling game is "*exceptional and pleasant*" (Binde 2009, p.87). In Binde's theory, the psychological and symbolic value of winning are the ingredients that help fulfil other motivations for leisure gambling (Binde 2009).

It is fair to say that this theory is in its early stages. However, it raises an interesting counterpoint to the prevailing view that gamblers gamble because of cognitive distortions.

3.2.2.3. Evolutionary Psychology

Evolutionary psychology is the scientific field that stands at the intersection of evolutionary biology and cognitive science (Cosmides & Tooby 1994). It is a field that may help to explain the circumstances under which people prefer to gamble (and to deviate from portfolio theory) rather than to take the safer decision. In this Part, I very briefly describe the field of evolutionary psychology and summarize what it might say about decision making under uncertainty.

Evolutionary biology posits that a trait of an organism will be selected for if that trait increases the fitness of the organism (Sterelney & Griffiths 1999). Fitness in this context means the rate at which genes are passed on to the next generation (Cosmides & Tooby 1994). The human brain will have evolved at least from the time that humanoids first appeared, with the traits that were most conducive to fitness being passed on from generation to generation. However, evolution is a slow process. During almost all this time that our brains were evolving, humans were hunter-gatherers living in small social groups, and so the architecture of the brain that humans now possess would have evolved to help people adapt to the environment in which hunter-gatherers found themselves, rather to our current environment. As the environment in which we now live is much different from the one in which our brains developed, our brains may not be as well suited to our current environment as they could be. In other words, our brains remain "*functionally specialized to solve problems that were characteristic of hunter-gatherer societies, rather than those of the modern world (e.g. habitat selection; foraging; social exchange; competition from small armed groups; parental care; language acquisition; contagion avoidance; sexual rivalry)*" (Cosmides & Tooby 1994, p.329).

Rational expectations models of economics are based on the assumption that our brains are general purpose instruments in the sense that they solve any type of problem using the same computational rules and the same logic (Kenrick et al. 2009; Haselton et al. 2009). Evolutionary psychology, on the other hand, posits that we use different systems for managing different challenges that we need to meet to survive and procreate (Kenrick et al. 2009). These include obtaining status, obtaining a mate, retaining a mate, obtaining friends, self-protection, caring for kin and self-protection. Evolutionary psychology also differentiates between proximate and

ultimate reasons for doing a thing (Tybur 2013). For example, the proximate reason for a man buying a Prius automobile may be to help the environment but the ultimate reason for doing so may be to increase his status, thereby becoming more attractive to women (Kenrick & Griskevicius 2013; Sexton & Sexton 2011).

Hunter-gatherers would have had to evolve mechanisms for assessing risk in many different circumstances (e.g. whether to risk injury by hunting or by challenging someone in the group for status) (Gigerenzer 2008; Cosmides & Tooby 1996). Those who were good at assessing those risks would have survived (and passed along their genes) to a greater degree than those who were not as good as assessing those risks. There is ethnographic evidence that *"in a variety of socio-economic systems and for a variety of behaviors, we are able to act as if capable of assessing outcome distributions, value functions and needs or aspiration levels, and of implementing effective, risk-sensitive actions"* (Winterhalder 2007, p.442). In many situations, we do not actually calculate the odds, but assess risk, variance and return using heuristics (Kahneman & Tversky 1973; Gigerenzer 2008). It may be that we apply those same risk assessment mechanisms to assessing financial risk.

The evolutionary biology concept of life history theory, which evolutionary psychology has adopted, posits that organisms must make decisions about how much time and resources to allocate to present reproduction as opposed to allocating resources to things like growth and survival, which will assist it in future reproduction (Kaplan & Gangestad 2005). The organism makes these decisions at any particular time based on such things as its sex, age and its subjective life expectancy (Kaplan & Gangestad 2005). Life history theory has been applied to human decision making (Wang et al. 2009). Evolutionary psychology stipulates that, in addition to risky decision-making being domain specific, it is also not stable over a person's lifetime. Whether a person takes a risky or a safe decision in any particular circumstance may also depend on where that individual is in his or her life cycle and on the particular environmental cues which that individual has been subjected to in the past or in the present (Wang et al. 2009). For example, single men (who are likely to be in mate acquisition mode) may make riskier decisions in order to acquire resources (which they will need to attract a mate) than married men, who might be more concerned with not losing resources because they are in mate retention mode (Frankenhuis & Karremans 2012).

Evolutionary psychology has been criticized as being a "just so" theory (Sterelney & Griffiths 1999). One problem is that since we evolved in an environment that is much different than the one which we now inhabit, the link between our evolutionary history and the current utility of that evolution is quite weak (Sterelney & Griffiths 1999). As well, environment can change the organism, so that putting an organism in an environment that is different from the one in which it evolved weakens the link between evolution and fitness.[44] As well, homo sapiens are the only surviving humanoids, so it is impossible to compare our traits to those of closely related species as biologists do with, for example, birds (Sterelney & Griffiths 1999).

While it is difficult to directly test evolutionary psychology theories by looking back through our evolutionary history, it is possible to test the theories experimentally. The general design of evolutionary psychology experiments is to prime the subjects in a treatment group to be in a certain mode (e.g. mating, disease avoidance) before conducting a task, then comparing the results of that task with the results from a control group who have performed the same task but who have not been primed. Priming involves subjecting subjects to a stimulus (e.g. viewing photographs or reading stories) with the purpose of determining whether exposure to that stimulus subconsciously influences subjects' behavior in a subsequent task (Shanks et al. 2013). A number of experiments (many of which I refer to later in the Part) have been conducted to test whether subjects' propensity to make risky decisions change if they are in a certain evolutionary mode. Under these experiments, subjects are generally primed to be in a specific evolutionarily important mode, such as mate acquisition mode or status seeking mode. They are then asked to engage in a task to determine whether they make risker decisions than subjects in the control group. As deviating from portfolio theory is riskier than abiding by portfolio theory, these experiments may also help to explain the ultimate reasons why people deviate from portfolio theory.

The balance of this Part applies evolutionary psychology theory and empirical evidence (including the experiments referred to above) to determine why people may under-diversify their stock portfolios and buy lottery-type stocks.

[44] For example, improved diets mean that people are taller now than 100 years ago, so it is not possible to say that human height optimizes fitness (Sterelney & Griffiths 1999, p.315)

3.2.2.3.1. Risk Sensitive Foraging Theory

Evolutionary biologists studying animal foraging behavior find that if there are two potential foraging areas open to an animal, it will choose the one that has less variability in yield even if the other has a greater expected yield, provided that the one with less variability in yield provides enough to sustain the animal (Ermer et al. 2008). This is known as risk sensitive foraging theory (Rode et al. 1999). From a survival point of view, this makes sense. More variability in yield might lead to some good feasts but it also leaves open the possibility of not eating for a few days and thus perishing. It is only when the less variable foraging area cannot sustain the animal that it will forage in the more variable area. The human brain evolved during a time that we were foragers, so it is reasonable to conjecture that we are also *"functionally specialized for making [foraging] decisions"* (Rode et al. 1999, p.300; also, Haselton et al. 2009). In other words, humans may have an evolved system for making risk-sensitive judgements that combines data about means, variance and need to come up with the optimal decision, without actually making the detailed calculations. Observations of groups who are still hunter-gatherers show that they typically make decisions that minimize the risk of not getting sufficient food, rather than maximizing the abundance of food (Kenrick & Griskevicius 2013; Kenrick et al. 2009).

If the human brain is specialized for making risk-sensitive resource acquisition judgements, then that same function could be used to make resource acquisition decisions for things other than food (Ermer et al. 2008). Indeed, risk sensitive foraging theory could be applied to stock market investing. Investors have the choice of adopting a low variance diversified approach or a higher risk undiversified approach. If taking a low variance portfolio approach to investing will not yield the investor enough to meet his or her goals, the investor will have to adopt a high variance undiversified portfolio approach to investing to have any chance of meeting those goals. This theory is consistent with the empirical evidence in finance that those who have less wealth tend to under-diversify their stock portfolios more than their relatively wealthy counterparts. Less wealthy investors may buy lottery-type stocks because getting a large payoff may be the only way for them to achieve their aspirations.

Risk-sensitive foraging theory may also be applied to the acquisition of status (Ermer et al. 2008). As discussed in Part III.2.c.ii., status is important to men because women prefer to mate with men who have it. If a man has insufficient status to attract a mate, he may have to

adopt a risky status-seeking strategy, as adopting the safe strategy means that he will fail in an evolutionary sense. Applying risk sensitive foraging theory to stock market investing, low status men would prefer a highly variable investment strategy while high status men would opt for a less variable strategy to make it less likely that they lose status (Daly & Wilson 2001). Accordingly, consistent with the empirical finance data, risk sensitive foraging theory predicts that low status men (proxied by those with relatively less wealth) would under-diversify and hold lottery-type stocks and that high status men would tend to hold a diversified portfolio.

3.2.2.3.2. Risk-taking to Acquire Status

It has been hypothesized that, like many mammals, humans evolved in small social groups in which status relative to others in the group was important, particularly for males (Ermer et al. 2008). Status determines mating opportunities and access to resources. Dominance theory is a well-developed evolutionary tool which is used to predict the circumstances under which animals will compete for status. As status is always a relative concept, competing for status is risky because an increase in one person's status necessarily means a relative reduction in another person's status. As a result, competing for status with other males may lead to injury (in humans, this might include social injury) if competitors decide to fight back (Ermer et al. 2008). Accordingly, deciding when and when not to compete for status is evolutionary very important for men and they should have developed mechanisms for assessing the risks and rewards of competing for status in any given circumstance. Competing for status includes competing for "*culturally valued resources*" (Ermer et al. 2008, p.107), such as money in our society. Cross-cultural studies show that women prefer men who have high status, but that men tend not to be concerned with women's status in determining a mate (Gray 2004).

One evolutionary reason for humans (and particularly for men) having evolved risk assessment capabilities is to be able to weigh the risks and rewards of acquiring resources to increase status and consequent mating opportunities. A well-developed mechanism for weighing these risks and rewards should lead to increased mating opportunities and increased fitness. In addition, taking risks to acquire resources may be a way to directly acquire a mate. Experiments have shown that when men are primed to be in mate acquisition mode they are more likely to take risks to acquire resources than men in control groups that have not been so primed (Baker &

Maner 2008).[45] There is also evidence that when the ratio between men and women is high, men make riskier financial decisions because men must compete more strongly for mating opportunities (Griskevicius et al. 2012). When the ratio of men to women is high, a man who takes a slow and steady approach to financial decision making may find that there are few potential mates available by the time he acquires sufficient resources to attract a mate. As well, men gamble more than women across cultures (Gray 2004).

The empirical evidence from finance is that single men under-diversify and hold lottery-type stocks to a much greater extent than women or married men. Single men may be adopting this investment strategy because they want a chance of a quick big win. A big win will increase their status and, accordingly, increase their chances of acquiring a mate. If the investment strategy does not pay off (i.e. the big win does not come through), they may be no worse off in terms of their chances of acquiring a mate than if they had followed a portfolio theory strategy (Griskevicius et al. 2012).

3.2.2.3.3. Risk-taking as Signalling

Risk-taking behavior itself might be a way for men to signal to women their value as a mate (Hugill et al. 2011). Risk-taking may signal attributes that are desired by women, such as confidence, ambition and mental acuity. Accordingly, male risk-taking may increase the number of mating opportunities (Baker & Maner 2009). Risk-taking may also be a way for men to signal their gene quality – the theory being that only men with good genes can bear the cost of engaging in unnecessarily risky behavior (Sundie et al. 2011). The theory is analogous to the theory of why peahens prefer peacocks with large showy tails. The tails are a signal of good genes as only peacocks with good genes could afford to carry around such unwieldy appendages and survive predators (Sundie et al. 2011).

Men who were primed with sexual/romantic arousal took more risks in a recent experimental task, but only when they were told that *"a romantically available female would view their performance"* (Baker & Maner 2009, p.1138). In an experiment to test whether women were more attracted to risk takers, men completed a questionnaire regarding their risk-

[45] Men are also inclined to accept a smaller amount today rather than to wait for a larger amount in the future in the presence of attractive women (Wilson & Daly 2004).

taking propensity, following which they performed a dance. Female participants were then shown a video (blurred to mask facial and physical attributes) of those men dancing and were asked to rate their attractiveness. Female participants reported being more attracted to dancers who had self-reported a high propensity to take risk (Hugill et al. 2011). In another study, women who were interested in short term relationships reported that they preferred men who were financial risk-takers (Sylwester & Pawłowski 2011). So, there is some evidence that financial risk-taking is in itself an attribute to which women respond positively. Accordingly, it may be that men under-diversify their stock market investments to signal to women their desirable qualities.

Risk-taking may also be a signal to other men. Daniel Fessler recently tested his hypothesis, which he calls the Crazy Bastard theory, that men engage in risky activity because men who become known as risk-takers are less likely to be challenged by other men. Fessler showed that men who engage in risky activity in an experiment were perceived by other men as having greater physically stature, even though they had the same physical stature as the non-risk-takers (Fessler et al. 2014). This is consistent with the results of an experiment conducted by Ermer *et al.* (2008) that men (but not women) make riskier financial decisions in the presence of men who they expect to compete with for status.

3.2.2.3.4. Life History Theory

As discussed in Part III.2.c., under life history theory, organisms allocate resources between current reproduction efforts and somatic effort, such as strengthening the body and survival. More somatic effort now may mean more future reproduction, but only if the organism survives. One variable that is relevant to the organism's allocation between current reproduction effort and somatic effort is the subjective life expectancy of the organism. Organisms which expect a long life tend to defer reproduction efforts and focus on somatic effort early in life, while those with a short life expectancy will start reproducing early in life (Griskevicius et al. 2011; Ellis et al. 2012). This has also been shown to be true within species (i.e. those individuals who have a short life expectancy will start reproducing sooner than those with a longer life expectancy) (Griskevicius et al. 2011). This ability to use environmental cues to trade off the risks of current versus deferred reproduction is evolutionary designed – those organisms who are

better at making these decisions will have better fitness than those organisms that are not good at making those assessments (Wang et al. 2009).

Life history theory has been applied to human behavior. Studies have shown that people who have a lower life expectancy at birth, who grew up with low socioeconomic status, or who grew up in violent or unstable environments are more likely to have children earlier in life (Griskevicius et al. 2011). Vladis Griskevicius conducted a series of experiments to test the hypothesis that the same relationship would hold with respect to financial decision making; that is, that those who grew up with low socioeconomic status would be more likely to make risky financial decisions. He hypothesized that people who grew up being uncertain about the future will use their environmental cues to take risks to increase their current wealth since future wealth will be of less subjective value to them. The results of the experiments were consistent with Griskevicius's hypothesis (Griskevicius et al. 2011).

The empirical evidence in finance is that relatively poor investors under-diversify more than richer investors (Kumar 2009). To the extent that there is a correlation between wealth during childhood and wealth in adulthood, the fact that less wealthy investors under-diversify is consistent with the life history theory. Relatively poor investors would be more likely to prefer a quick big win than richer investors and would be less interested in following a slow and steady diversified investment strategy because they subjectively believe that they may not live long enough to enjoy the fruits of the slow and steady strategy.[46]

Life history theory may explain why single men disproportionately under-diversify their investment portfolios and hold lottery-type stocks. Single men are more likely to be in the mate acquisition stage of their life history. Accordingly, they may be disposed to take risks to acquire resources and status, which may increase their chances of acquiring a mate (Daly & Wilson 2001). Married men, who are more likely to be in mate retention mode, may be more concerned with not losing resources and, accordingly, they may be more likely to take a slow and steady diversified portfolio approach than single men (Daly & Wilson 2001). The finance evidence in

[46] In a recent experiment, participants who came from a lower childhood socio-economic background and who were primed for mortality threats chose more diversified portfolios. However, that experiment was not directly testing risk-reward trade-offs since participants in that experiment were not given any information about the risk or return on the portfolios from which they could choose (White et al. 2013).

consistent with the life history theory, as it shows that single men under-diversify and hold lottery-type stocks to a much greater degree than women or married men.

3.2.3. Summary of Evolutionary Reasons for Under-diversifying

The finance studies summarized earlier in this chapter illustrate that individual investors who have certain demographic attributes, such as low socioeconomic status, being single, being male and being young, are more likely to under-diversify their stock portfolios. Evolutionary theories of human risk-taking predict that people with those same demographic attributes will take risky decisions to meet certain evolutionary challenges, such as mate acquisition. Accordingly, it may be that people under-diversify and buy lottery-type stocks to (consciously or unconsciously) meet these evolutionary challenges. Whether that investing behavior is actually beneficial to investors is an open question; that is, does deviating from portfolio theory really help investors meet those evolutionary challenges, or is the perceived benefit illusory?

It ought to be possible to experimentally test whether there are evolutionary explanations for individual investors' under-diversifying. The framework of the experiment would be to prime participants to be in, say, mate acquisition mode before having them participate in an investment game. Their investment behavior would then be compared to the behavior of a control group that participated in the same investment game. Another approach is to test whether low status males make different investment decisions than high status males in a simulated investment game.

4. Conclusion

Individual investors deviate from portfolio theory by trading too much and under-diversifying their stock portfolios. The empirical evidence in finance is that these deviations are very costly to investors. Individual investors incur unnecessary commissions and other transaction costs associated with trading and they are not adequately rewarded for the risk they take on by holding undiversified portfolios. In addition, their preference for lottery-type stocks result in the expected returns on those stocks being lower than the CAPM predicts.

A rational individual investor who was only interested in maximizing his or her expected investment returns would adopt a buy and hold strategy and would avoid lottery-type stocks. The

observed fact that individual investors do not follow this investment strategy might mean that they deviate from portfolio theory to satisfy current needs.

The needs that individual investors may be attempting to satisfy by deviating from portfolio theory may be evolutionarily driven. Numerous studies in finance show that investors who are young, single, male or who have relatively low wealth tend to deviate from portfolio theory more than investors in other demographics. These results are consistent with the evolutionary psychology literature on risk-taking. That literature finds that young, single men of low status make riskier decisions than others, particularly when they are primed for status seeking or mate acquisition. It ought to be possible to test the evolutionary psychology theories for portfolio theory deviation through experiments in which investors are primed for status seeking or mate acquisition and then observing their investment behavior as compared to a control group that was not so primed. In chapter 2, I report on the results of an experiment I conducted to test whether males who have been primed to be in mate-seeking mode under-diversify more than those who have not been so primed.

[Chapters 3, 4 and 5 redacted]

Chapter 6: Concluding Remarks

1. Summary and Findings

The evidence from finance and behavioral economics is that people are generally not very good at managing their retirement savings.[1] People tend to save too little, pay high investment management fees, under-diversify their portfolios and draw down their savings too soon (Benartzi & Thaler 2007).

While behavioral economists have identified the biases and heuristics behind many of the bad financial decisions that people tend to make, they have yet to even propose an overarching theory for why people make these mistakes. The contribution of this dissertation is to suggest a framework within which to explain why people make bad financial decisions. The framework that I develop in this book is based on natural selection and evolutionary psychology.

Evolutionary psychologists assume that we use different modules of the brain to solve different problems. As saving for retirement using financial instruments is a very recent problem, and not one that our distant ancestors had to solve to survive and reproduce, the human brain has not evolved to effortlessly solve problems of saving for consumption far into the future. Accordingly, we use modules that evolved to solve other problems to solve problems relating to retirement savings. As a result, the retirement savings decision that a person makes may depend on which evolutionarily important issue is salient at the time of making the decision. For example, if mate-seeking is salient, the person might make riskier decisions and if self-protection is salient (e.g. because a terror attack is in the news), the person might make a less risky decision.

As discussed in detail in chapter 2, evolutionary psychology assumes that humans use different systems to solve different evolutionarily important problems. Economists, on the other hand, assume that the human brain is a general-purpose instrument – that it uses the same systems to solve all problems. This is perhaps one reason why economists have been very slow

[1] As discussed in section 2 below, this may explain why governments are involved in regulating retirement savings at all.

to adopt evolutionary psychology to explain peoples' tendency to make poor retirement savings decisions (Kenrick & Griskevicius 2013).

In chapter 2, I develop a comprehensive theory as to how evolutionary psychology can explain the observations that individuals make systematic mistakes in their retirement savings planning, focussing on the mistake of portfolio under-diversification. I base this theory on existing empirical evidence from finance, evolutionary psychology, psychology and neuroscience. I show how evolutionary psychology and neuroscience experiments, and recent psychology literature on gambling may all help to explain the data from finance and behavioral economics which shows that people make systematic mistakes in their investment behavior. The intent of that chapter is only to suggest how evolutionary psychology could explain the retirement savings mistakes that have been observed. The chapter does not prove that those mistakes are caused by brains that are ill-evolved to deal with modern finance. It merely sets the groundwork for designing and conducting experiments that may eventually support or disprove the theory.

In chapter 3, I report the results of an experiment which I conducted to test one of the hypotheses that I developed in chapter 2. The hypothesis is that males for whom mate-seeking is salient will under-diversify their stock portfolios more than other males. The results of the experiment show that males for whom mate-seeking is made salient did under-diversify their stock portfolios more than men in the control treatment for whom mate-seeking was not made salient. While this result lends support for using an evolutionary psychology approach, caution must be taken when applying the results. I was not able to fully rule out other reasons for the difference in behavior for those in the treatment group from those in the control group, such as a differential impact of the treatment on mood. Furthermore, the result was from just one experiment, and that experiment was not incentivized. The results could well be different in an incentivized experiment or when males are investing for retirement in the real world. A follow-up experiment to further test the theory would be to run the same experiment using only female subjects and showing those in the treatment group photographs of attractive males. Evolutionary psychology theory is that viewing those photographs would have no impact on the diversification decisions of females. Thus, a finding that females' diversification decisions are unaffected by the treatment would further support the theory. Another follow-up experiment would be to make self-preservation salient (e.g. by showing photographs of war scenes) to see whether, as

evolutionary psychologists predict, subjects would diversify their portfolios more than those in the control treatment.

Chapter 4 is a theory paper in which I develop the hypothesis that the evolutionarily important emotion of regret may explain many of the mistakes we observe people making in their retirement savings planning. The importance of regret is that people who feel it tend to make better decisions than those who do not (Camille et al. 2004), which would have helped our ancestors survive and reproduce. I describe many of the retirement savings mistakes and anomalies that finance scholars have observed (mostly) using data from actual retirement savings plans. These include an excess reliance on defaults, making the same decisions as peers and paying for costly management advice. I then describe the empirical evidence from regret experiments conducted by psychologists and economics. Based on the those experiments, I suggest that a desire to minimize future regret may explain the observed retirement savings mistakes and anomalies. As is the case for chapter 2, I make no claim in chapter 4 to have proven that regret explains retirement savings mistakes. I merely set the groundwork for future experiments that may support or disprove the hypotheses set out in that chapter.

Chapter 5 reports on an incentivized online experiment that I conducted with Pieter Desmet to test two of the hypotheses developed in chapter 4; namely that people rely on defaults and that they make the same investment decisions as their peers to minimize future regret. In the experiment, subjects decided between 2 lotteries, Lottery A and Lottery B, and reported on their anticipated regret and how responsible they felt for their decision. Those in the Free Choice treatment simply chose between the two lotteries. In the Default treatment, Lottery B was set as a default and, in the Peer Choice treatment, subjects were told that in a previous experiment, Lottery B was preferred. The Default treatment "worked", in the sense that a much greater percentage of subjects chose Lottery B than in the Free Choice treatment. However, the Peer Choice treatment had no significant effect on lottery choice.

Those in the Default treatment who opted out or imagined opting out of the default reported that they would feel more regret in a bad outcome of that lottery than those in the Free Choice treatment who chose or imagined choosing Lottery A. Accordingly, the results support the hypothesis that the default was effective because opting out of a default induces regret and that people stick to the default to avoid this regret. However, as with the experiment reported in

chapter 3, caution should be exercised in applying the results to the real world. We conducted just one experiment, and the result we obtained may well be an artifact of the specific design of the experiment. In addition, we could not identify the pathway through which regret functions; that is, whether people who opted out of the default felt more regret because they felt more responsible for their decision or for some other reason.

Further research is required to come to firmer conclusions. For example, one reason for people to accept the default is that they find it difficult to calculate the expected return or variance of the lotteries. Choosing the default allows them to avoid the cost of making such a choice. One refinement of our experiment would be use payouts and percentages that are not round numbers (e.g. 43.6% chance of winning $3.79). Perhaps people would be more likely to stick to the default in these cases to avoid the cost of making the calculations.

In conclusion, the experiments that are reported in this dissertation support the hypotheses that they tested. The first experiment showed that people's portfolio diversification decision may be affected by which evolutionarily important problem is salient. The second experiment showed that the evolutionarily important emotion of regret may play a role in people's decisions to accept defaults.

The framework that I have developed in this book for analyzing why people make retirement savings mistakes assumes that our brains have not had enough time to evolve to easily solve problems relating to retirement saving planning, including portfolio diversification. Accordingly, people will use modules that were evolutionarily designed to solve other problems to solve problems such as how much to diversify their portfolios. The results of the experiment reported in chapter 3 lend some support for that framework of analysis. The evidence from evolutionary psychology is that males take greater risk when mate-seeking is made salient because taking more risk provides a greater chance of a larger, more immediate gain, which may help in obtaining a mate. In the experiment, when mate-seeking was made salient, subjects under-diversified their portfolios more (i.e. they took more risk) than subjects for whom mate-seeking was not made salient. This suggests that subjects relied on a module that was evolutionarily designed to solve problems related to finding aa mate to help solve portfolio diversification decision.

As discussed in chapter 4, regret evolved at a time that humans were hunter-gatherers living in small groups. The ability to experience regret was likely fitness enhancing because it induced people to take more care in their decision-making, thereby reducing the chance of feeling that emotion. The results of the experiment reported in chapter 5 suggests, however, that regret may not be well suited for making decisions that were not relevant to our distant ancestors. Subjects' decision-making was influenced by whether there was a default, and the experiment provided evidence that the default was effective because subjects wanted to avoid Opt-out regret. Rather than assess the two lotteries, some subjects in the Default treatment merely stuck to the default lottery, perhaps to avoid deciding at all. This suggests that the evolved emotion of regret is not well-suited to financial decision making as their choice depends, to some extent, on which option happens to be set as a default.

The achievement of this dissertation is to take the first steps in developing a coherent theory to explain the biases and heuristics that have been identified by behavioral economists, at least as they apply to retirement savings planning and stock market investing. While others have suggested that these biases and heuristics arise from our evolutionary past, to my knowledge, no one has yet attempted to apply evolutionary principles to explain these biases and heuristics in the retirement savings domain. I hope that I am not the last to do so, and that others will build upon my work.

2. Implications for Retirement Savings Policy

In a nutshell, the hypothesis of this dissertation is that people make systematic mistakes in their retirement savings planning because the human brain has not evolved to easily solve problems relating to retirement savings. In this section, I summarize below the policy implications for government regulation of retirement savings regulation that have previously been discussed in section 6 of chapter 3 and in section 6 of chapter 4. Before doing that, however, I provide some background to (i) what I believe is the main policy rationale for why governments regulate retirements savings and (ii) why governments and employers have shifted from defined benefit plans to defined contribution plans.

Why are governments involved at all in providing pensions or mandating and subsidizing retirement savings? According to standard economic models, individuals temporally maximize their utility by smoothing their income over their lifetimes. That is, they will borrow early in their working lives, save in their middle years and draw down their savings in retirement. If, indeed, people act in accordance with this theory, the need for governments to be involved in retirement savings is not obvious – individuals will maximize their utility by acting in accordance with their temporal consumption preferences.[2] Most countries, however, either provide pensions to their citizens, mandate a minimum amount of retirement savings or provide tax benefits to encourage individuals to save for their retirement.[3]

There are two rationales in the pension policy literature for governments being involved in the provision of pensions. The first is the alleviation of poverty. Through misfortune, some people will not be able to save enough to support themselves in retirement. The rationale is that these people ought to be able to live out their old age in at least a modicum of comfort (European Commission 2015). The second, and by far the most commonly stated rationale, however, is that working individuals ought to be able to maintain in retirement the standard of living that they enjoyed while working. This second rationale has been the implicit focus of this dissertation. The very fact that policymakers throughout the world (including intergovernmental organizations such as the World Bank and the OECD[4]) call for government provision or subsidization of

[2] Within the traditional economics framework, one reason for providing pensions and subsidizing retirement savings is the externality identified in overlapping generations models (Weiss 1991). Those models suggest that savings in a society will be less than the socially optimal amount because some of the benefits of savings and investment accrue to future generations. In the absence of compulsion or subsidies, individuals will not take this externality into account and will save too little. Accordingly, compulsory or subsidized pensions can increase social welfare by increasing the aggregate savings rate. However, it is not clear that, even if this externality exists, pension legislation is the appropriate regulatory tool to get to the socially optimal level of savings. In any event, neither government policy discussions nor the academic pension literature suggests that an increase in aggregate savings is a policy objective of pension legislation.

[3] See (OECD 2016) for a recent summary of pension legislation in OECD and selected other countries.

[4] The World Bank suggests that countries institute multi-pillar pension systems (Holzmann & Hinz 2005). The first pillar, a non-contributory minimum retirement income, is intended to relieve against old age poverty. The additional pillars, which provide for mandatory and voluntary retirement savings, are intended to provide for replacement income based on income earned during working years. See also (OECD 2013).

retirement income suggests that there is a widespread belief that people will not save enough for their retirement without government involvement.

As discussed in chapter 1, due to steadily increasing life expectancies and for other reasons, providing retirement income became much costlier for governments and employers than they forecasted at the time that the plans were established. Over the past few decades, many governments instituted changes to their pension systems to reduce these costs and to reduce the uncertainty of future pension funding costs. One of the changes that government made was to switch from providing pension benefits through DB plans to mandating (or subsidizing) savings through DC plans in which individuals take on the risks associated with future increases in longevity and risks such as investment returns being lower than forecast. In some cases, like Australia, governments provided for mandatory contributions to self-administered DC plans. In other cases, like Germany, governments provided tax subsidies to those who contribute to DC plans, but did not mandate contribution levels. At the same time, private-sector employers in the Anglo countries also switched from DB plans to DC plans.

In almost all cases, the switch from DB plans to DC plans resulted in much of the decision-making relating to retirement savings plans (e.g. contribution rate decisions, asset allocation decisions, drawdown decisions) being transferred to individuals. Given the implicit rationale for retirement savings legislation that people do not, on their own, save enough for retirement, this seems like an odd policy proscription. It is important to note, however, the dearth of discussion in the literature on whether switching to DC plans would result in individuals would making better or worse pension decisions than governments and employers did under DB plans. The transfer to individuals of responsibility for managing retirement savings plan was, in a sense, merely a by-product of a desire on the part of governments and employers to reduce pension costs by, in part, shifting from DB plans to DC plans. Little thought appears to have been given as to whether most individuals would make good retirement savings decisions.

The reason for reducing pension payments and transferring risk to individuals is clear. Pension payments as a percentage of GDP were increasing rapidly and were forecast to increase even more in the future. There was a feeling in many countries that pension systems were not sustainable in the long-run. The mistake, I believe, was putting responsibility onto individuals for retirement savings decision-making despite the evidence that they were not be up to the task. If,

as hypothesized in the dissertation, people make mistakes in managing their retirement savings plans, such as under-diversifying, paying excess fees and under-contributing to their DC plans, because the human brain has not evolved to easily solve problems relating to saving for retirement, then it will be very difficult to change this behavior. In fact, to the disappointment of economists, there is a substantial amount of evidence that financial education and disclosure has not lead to better retirement savings decision-making (Willis 2011; Bubb & Pildes 2014; Benartzi & Thaler 2007).

As discussed, the main policy goal of government involvement in providing retirement income is to increase the percentage of retirees who enjoy the same standard of living in retirement that they did during their working years. I suggest that, for two reasons, that policy goal would be better accomplished through DB plans. Firstly, DC plans are much costlier to administer than DB plans. Therefore, a given amount contributed to a DC plan will generate less retirement income than the same amount contributed to a DB plan. A major reason why DC plans are more expensive than DB plans is that people pay asset management fees for actively managed funds which generate returns that are no higher than passively managed, lower-cost funds. As discussed in chapter 4, regret may explain this tendency to pay for active management, and this may make it difficult to induce people to switch to lower cost, well-diversified index funds.

Secondly, in DB plans where participants contribute a set percentage of their income to pooled investments (i.e. all participants in the plan have an undivided interest in the plan assets), all participants in the same cohort will receive a similar retirement income (as a percentage of their earnings). However, in DC plans, where participants contribute at different rates and invest in different assets, retirement incomes among those in the same cohort will vary much more than in DB plans. Accordingly, some DC plan participants (e.g. those who did not contribute enough or those who under-diversified and got unlucky) will not have enough DC plan assets to allow them to maintain in retirement the standard of living that they enjoy while working. If, as hypothesized in the dissertation, people make mistakes of under-diversifying and under-contributing to their DC plans because the human brain has not evolved to easily solve problems relating to saving for retirement, then it will be very difficult to change this behavior.

Mandatory DC plan regimes would solve the problem of individuals not contributing enough to provide a sufficient retirement income. However, mandatory plans still leave open the possibility of under-performing the market (and therefore earning low retirement income) due to paying excess management fees or under-diversifying. Therefore, the policy approach that my research suggests is to move away from individual, self-managed retirement plans and towards a pooled, funded system, but one in which retirement income can be adjusted if forecasts of factors such as investment returns or longevity turn out to be inaccurate. In my view, the Dutch private pension regime is a very good model.

The Dutch system consists of a public PAYG pension plan which pays to all retirees who have lived in the Netherlands for a minimum number years a pension that is a percentage of the country's minimum wage. The unique part of the Dutch system, however, is the quasi-mandatory pension scheme offered by employers (either on a company-wide or industry-wide basis) that cover more than 90% of employees. Those private pension schemes pay in the range of 70% of average lifetime earnings for the average worker (OECD 2015; OECD 2013). The Dutch private pension system is called quasi-mandatory because there is no legal requirement for employers to provide a pension, but most do. If an employer provides a plan, however, the plan must comply with pension funding rules that are much stricter than in most other countries (Beetsma et al. 2015).

Under the Dutch pension legislation, the value of a pension plan's assets must, at all times, exceed the present value of its liabilities. If a plan fails to be fully funded because, for example, average life expectancy increases or investment income falls, steps must be taken to become fully funded. These steps may include adjusting payments to existing retirees or increasing contribution rates. Part of the reason for this feature is that it would be unfair for one generation to be subsidizing the retirement benefits of another generation. The flexibility to adjust pension payments allows fund managers to fully fund the plan in a way that maintains fairness among generations. During the recent financial crisis, pensioners had their payments frozen (i.e. not indexed to inflation) to allow the private pension funds to meet their funding requirements. In other cases, pension payments were cut and contribution rates were raised (Beetsma et al. 2015).

In conclusion, the Dutch private pension system gives the benefits of pooling (i.e. low cost, professional asset management and mandatory contributions) with the flexibility to adjust pension payments and contribution to meet changed circumstances. For those reasons, I suggest that it is superior to DC plans. This is even more relevant if the reason that individuals make systematic mistakes in managing their retirement savings plans is that the human brain has not evolved to easily make retirement savings decisions.

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Summary

I was motivated to write this book by the evidence that individuals make costly systematic investment mistakes in their retirement savings planning, such as investing in the wrong assets and under-diversifying their portfolios. These mistakes are difficult to explain using the toolbox of traditional economists. Behavioral economists have stepped into the breach to explain that people make these mistakes because they rely on heuristics and have certain biases in their thinking. However, behavioral economists have yet to develope a unifying theory as to why people have these biases and rely on heuristics.

In this book, I develop and test the theory that this bad investment behavior results from traits that evolved to help our distant ancestors survive and reproduce. I describe why it is important to understand the evolutionary history of our brains in order to understand why we may not be very good at solving retirement savings problems.

In the first substantive chapter, chapter 2, I apply evolutionary psychology to explain one of the mistakes that individuals have been shown to make in their retirement planning – the mistake of under-diversifying their portfolios. While the chapter is focussed on explaining when and why individuals may under-diversify their stock portfolios, the theoretical discussion on evolutionary psychology theories put forward in the chapter can explain why and when individuals will make other seemingly sub-optimal decisions relating to their retirement planning.

In chapter 3, I report on an online experiment that I conducted to test a hypothesis that I put forward in chapter 2; that is, that males for whom mate-seeking is salient under-diversify their stock portfolios more than other males. The results of the experiment support this hypothesis.

Regret is an emotion that evolved to help humans learn from their mistakes, which enhanced their survival and rates of reproduction. I hypothesize in chapter 4 that people make retirement savings decisions in such a way as to minimize regret. I also explain in that chapter why regret may also explain why defaults work so well in the retirement savings domain – people follow defaults because it is a regret reducing strategy.

Chapter 5 reports on an experiment that was conducted to test the hypothesis that regret may explain why defaults and communicating preferences of peers are so effective in changing behavior. The results of the experiment support this hypothesis.

Samenvatting

Ik was gemotiveerd om dit boek te schrijven omdat blijkt dat individuen bij hun pensioenplanning kostbare systematische investeringsfouten maken, zoals het investeren in de verkeerde activa en het onvoldoende diversifiëren van hun portefeuilles. Deze fouten zijn moeilijk te verklaren met behulp van de instrumenten die traditionele economen ter beschikking hebben. Gedragseconomen zijn in de bres gesprongen om uit te leggen dat mensen deze fouten maken omdat ze vertrouwen op heuristiek en bepaalde vooroordelen hebben in hun denken. Maar gedragseconomen moeten nog steeds een verbindende theorie ontwikkelen over waaróm mensen deze vooroordelen hebben en op heuristiek vertrouwen.

In dit boek ontwikkel en test ik de theorie dat dit slechte beleggingsgedrag het gevolg is van eigenschappen die zijn ontwikkeld om onze verre voorouders te helpen overleven en zich voort te planten. Ik beschrijf waarom het belangrijk is om de evolutionaire geschiedenis van onze hersenen te begrijpen om te begrijpen waarom we misschien niet erg goed zijn in het oplossen van problemen op het gebied van pensioensparen.

In het eerste inhoudelijke hoofdstuk, hoofdstuk 2, pas ik evolutionaire psychologie toe om een van de fouten te verklaren die individuen aantoonbaar maken in hun pensioenplanning - de fout om hun portefeuilles onvoldoende te diversifiëren. Terwijl het hoofdstuk vooral is bedoeld om uit te leggen wanneer en waarom mensen hun aandelenportefeuilles onvoldoende zouden kunnen diversifiëren, kan de theoretische discussie over theorieën uit de evolutieve psychologie die in het hoofdstuk wordt gepresenteerd verklaren waarom en wanneer personen andere schijnbaar suboptimale beslissingen nemen met betrekking tot hun pensioenplanning.

In hoofdstuk 3 doe ik verslag over een online experiment dat ik heb uitgevoerd om een hypothese te testen die ik in hoofdstuk 2 heb uiteen gezet; de hypothese dat mannen met een opvallende drang naar het vinden van een maatje hun aandelenportefeuille meer onderdiversifiëren dan andere mannen. De resultaten van het experiment ondersteunen deze hypothese.

Spijt is een emotie die is ontwikkeld zodat de mens leert van zijn fouten, waardoor zijn kans op overleven en voortplanting is toegenomen. In hoofdstuk 4 stel ik de hypothese dat mensen hun beslissingen over pensioensparen zodanig nemen dat ze er zo min mogelijk spijt van krijgen. Ik leg in dat hoofdstuk ook uit waarom spijt tevens kan verklaren waarom standaard oplossingen zo

goed werken op het gebied van pensioensparen - mensen volgen standaard oplossingen omdat het een spijt-reducerende strategie is.

Hoofdstuk 5 beschrijft een experiment dat werd uitgevoerd om de hypothese te toetsen die stelt dat spijt kan verklaren waarom standaardinstellingen en communicatievoorkeuren van gelijkgestemden zo effectief zijn in het veranderen van gedrag. De resultaten van het experiment ondersteunen deze hypothese.

Academic Positions

Since 10/2015

European Doctorate in Law and Economics (EDLE)
Ph.D. Candidate, University of Haifa, Israel, an EDLE affiliated university.
Focus: law and economics analysis of finance.

01/2014 – 09/2015

Ghent University School of Law: Center for Advanced Studies in Law and Economics
Ph.D. Candidate.
Focus: law and economics analysis of finance.

Non-Academic Experience

1998 – 2010

Billion Capital Management Limited
I operated a small business that was focused on buying and selling publicly-traded Canadian securities (the "derivative securities") that derived their value from other publicly-traded securities (the "underlying securities"). The business objective was to take advantage of pricing differences between the derivative securities and the underlying securities.

1987 - 1998

Torys LLP
I practiced tax law at a Toronto based corporate law firm, Torys, where I primarily provided Canadian corporate tax advice on transactions such as mergers and acquisitions and financings. I started at Torys in 1987 as a summer student and became a partner in 1997.

Education

10/2012 – 08/2013

Master in Laws (LL.M.)
University of Haifa, Israel

European Master in Law and Economics
Ghent University, Belgium

Master in Law and Economics
University of Bologna, Italy

Note: the foregoing 3 degrees were all granted pursuant to the European Master in Law and Economics program.

08/2010 – 07/2011 **Master of Science (M.Sc.) – Finance (Cum Laude)**
Tilburg University, The Netherlands
Focus: investment analysis, corporate governance, capital structure and empirical methods.

09/1985 – 06/1988 **Bachelor of Laws (LL.B.)**
University of Toronto, Canada
Focus: business and tax law

09/1983 – 06/1985 **Bachelor of Arts (B.A.) – Economics**
University of Western Ontario, London, Canada

Honors and Academic Awards

11/2013 **Covington & Burling Prize – European Master in Law and Economics**
For writing the best thesis of the year.

06/1987 **Smith, Lyons, Torrance, Stevenson & Mayer Prize – University of Toronto**
For attaining the highest place in Business Organizations II: Corporate Finance.

06/1985 **Governor General's prize – University of Western Ontario**
For attaining the highest place in a three-year degree program.

Conferences, Workshops, etc.

2017 **Empirical Legal Studies Workshop, May 24th, Erasmus University Rotterdam**
Presentation: "Do Men Take Greater Stock Market Risk When Seeking a Mate?"

EMLE Midterm Conference in Law & Ecomonics, February 17th, Ghent Univeristy
Presentation: "Do Men Take Greater Stock Market Risk When Seeking a Mate?"

2016 **Human Evolution and Behavior Network, December 15th-16th, University of Antwerp**
Presentation: "Do Men Take Greater Stock Market Risk When Seeking a Mate?"

Course in Programming Economic Experiments with z-Tree, February 29th–March 2nd, University of Konstanz

2015 **11th Italian Society of Law and Economics Conference, December 17th–18th, Università di Napoli Federico II**
Presentation: "Investing in the Stock Market for Sex: Evidence and Regulatory Approaches"

32st European Association of Law and Economics Conference, September 18th–20th, University of Vienna.
Presentation: "Investing in the Stock Market for Sex: Evidence and Regulatory Approaches"

2015 Comparative Law and Economics Forum (CLEF), June 11th–14th, Belgium (Leuven and Ghent).
Presentation: "Stock market Investing and Evolutionary Psychology"

2014

31st European Association of Law and Economics Conference, September 18th–20th, Aix-Marseille Université.
Presentation: "Is Underwriter Hold-up a Cause of Too Few IPOs?"

26th Human Behaviour and Evolution Society Conference, July 29th–August 2nd, Natal, Brazil.
Presentation: "Stock Market Investing as Evolutionary Driven Current Consumption"

1st Ghent University Center for Advanced Studies in Law and Economics Conference and 12th Annual German Law and Economics Conference, July 11th–12th, Ghent University.
Presentation: "Stock Market Investing as Evolutionary Driven Current Consumption"

2014 EMLE Law & Economics Workshop, February 14th, University of Bologna.
Presentation: "Is Underwriter Hold-up a Cause of Too Few IPOs?"

2013

9th Italian Society of Law and Economics Conference, December 12th–13th, University of Lugano (USI).
Presentation: "Is Underwriter Hold-up a Cause of Too Few IPOs?"

EDLE PhD Portfolio

Name PhD student : Stephen Billion
PhD-period : 2015 - 2018
Promoters : Prof. dr. Michael Faure; Dr. Alan Miller
Co-promoter : Dr. Pieter Desmet

PhD training

Bologna courses	***year***
Introduction to European Competition Law	2015
Experimental Economics - Methods	2015
Causal Inference	2015
Modelling Private Law	2015
Experimental Economics - Topics	2015 - 2016
Behavioural Law and Economics	2016
Game Theory and the Law	2016
Specific courses	***year***
Seminar 'How to write a PhD'	2016
Academic Writing Skills for PhD students (Rotterdam)	2016
Seminar Series 'Empirical Legal Studies'	2017
Seminars and workshops	***year***
Bologna November seminar (attendance)	2015
BACT seminar series (attendance)	2016 - 2017
EGSL lunch seminars (attendance)	2016 - 2017
Joint Seminar 'The Future of Law and Economics' (attendance)	2017
Rotterdam Fall seminar series (peer feedback)	2016
Rotterdam Winter seminar series (peer feedback)	2017
Empirical Legal Studies Workshop	2017, 2018
Presentations	***year***
Bologna March seminar	2015
Hamburg June seminar	2016
Rotterdam Fall seminar series	2016
Rotterdam Winter seminar series	2017
Bologna November seminar	2017

Joint Seminar 'The Future of Law and Economics'	2018
Attendance (international) conferences	***year***
European Association of Law and Economics Conference (Vienna)	2015
Italian Society of Law and Economics Conference (Naples)	2015
Human Evolution and Behaviour Network Conference (Antwerp)	2016
EMLE Mid-term Meeting (Ghent)	2017
Teaching	***year***
Others	***year***
zTree Programming course (Konstanz, Germany)	2016