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TWO ESSAYS ON LEARNING DISABILITIES IN THE APPLICATION OF FUNDEMENTAL FINANCIAL PRINCIPLES

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A DISSERTATION

Presented to the Faculty of

The Graduate College at the University of Nebraska-Lincoln

In Partial Fulfillment of the Requirements

For the Degree of Doctor of Philosophy

Major: Business Administration
Finance Concentration

Under the Supervision of Professors Gordon Karels and Thomas Zorn

Lincoln, Nebraska

August, 2010

TWO ESSAYS ON LEARNING DISABILITIES IN THE APPLICATION OF FUNDEMENTAL FINANCIAL PRINCIPLES

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University of Nebraska-Lincoln, 2010

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This dissertation consists of two essays which examine the relationship between dyslexia and the application and acquisition of financial knowledge. Recent behavioral research has documented that factors such as representativeness, overconfidence, loss aversion, naiveté, wealth, age and gender all impact a person's risk perception and asset allocation decisions. Through the use of a simulated 401(k) asset allocation exercise, the first essay of this dissertation presents a preliminary case study which examines whether dyslexia, a specific learning disability which is neurobiological in origin, influences these critical investment decisions. The second essay explores the effectiveness of the use of color coding and a modified version of the Jalbret (2002) technique for teaching time value of money to dyslexic students.

Acknowledgements

I would like to thank my advisors, Dr. Gordon Karels and Dr. Thomas Zorn for believing in me and allowing me to work on such a different topic. My thanks also go out to my committee members: Dr. Manfred Peterson and Dr. Kathleen Wilson. I have benefited from the support of my colleagues: Jin, Stoyu, Rashiqa, Brian, Jiri and Jeff though out the years and owe them a debt of gratitude. Finally I thank my parents and my wonderful husband Kyle for their love and support.

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Essay 1: An Analysis of the Relationship between Dyslexia, Risk Perception and 401(k) Allocation Decisions

1. Introduction

In recent years, following the decline in popularity (and for many firms, the financial feasibility of) defined benefit retirement plans, 401(k) plan allocations have become one of the primary financial decisions faced by working individuals in the United States. As of 2001, 45 million Americans held 401(k) plans totaling $1.75 trillion in assets (Holden and VanDerhei, 2001). In light of the importance of these decisions it is interesting to investigate how investors make these allocation decisions. According to the traditional finance paradigm, these investors, acting as perfectly rational, risk adverse, utility maximizing agents in a perfect market with no transaction costs or informational asymmetries will select the optimal portfolio by simultaneously minimizing risk and maximizing return. Unfortunately, we do not live in this perfect world; instead as the field of behavioral finance has shown, market frictions, both economic and emotional, influence our decisions. Behavioral research has documented that biases such as representativeness, overconfidence and fear can influence an investors risk perception; while, factors such as gender, naivety, regret and loss aversion can influence asset allocation decisions.

In general, financial theory holds that people make investment decisions by analyzing the risk of an investment alternative, and then deciding whether or not to purchase the asset based on their risk tolerance and/or the degree to which

the asset will provide a diversification benefit for their current portfolios. Therefore, an individual's risk perception plays a key role in his/her investment decisions. Representativeness is an over-reliance on stereotypes. This bias causes investors to view recent trends as representative of the underlying process and thus form inaccurate expectations and risk perceptions. The representativeness bias has been shown to contribute to inaccurate assessments of investment value and risk (De Bont and Thaler, 1985; Shefrin and Statmen, 1995). Anchoring is a related bias whereby people rely too heavily on one piece of available information and fail to accurately update their expectations as new information becomes available. De Bont (1993) used this heuristic to explain why investor's forecasts of an assets value tend to center around their initial purchase price.

Overconfidence has also been shown to impact risk perception. The overconfidence bias is the tendency for people to overvalue their own knowledge, abilities and contributions. This heuristic can lead investors to underestimate risk and overestimate their ability to beat the market (Daniel et al., 1998)

Psychology literature has long held that women tend to be more risk adverse then men (Byrnes, 1999). With respect to financial decisions, Olsen and Cox (2001) found that female finance professionals (CFAs and CFPs) placed greater weight on downside risk than did their male colleagues. They also documented

that women appear to be more sensitive to ambiguity and uncertainty with respect to their investments.

While the impact of downside risk is heightened in women, its influence is not limited to them alone. Koonce et al. (2004) find that higher potential loss outcomes lead to greater risk perceptions.

Just as risk perception can be influenced by behavioral biases, so too can asset allocation. Sunden and Surette (1998) found that women hold a larger proportion of their retirement portfolios in lower risk assets. Wang (1994) documented that as a consequence of this belief, financial advisors often steer their female clients towards less risky investments.

Naivety is another oft sighted determinant of asset allocation. It is a common assumption that it is preferable to hold a “diversified portfolio,” but since the ability to effectively choose such a portfolio eludes many, they naively diversify by dividing their funds evenly across the available asset choices. This phenomena has been studied by Benartzi and Thaler (2001) and Hubner and Jiang (2006).

Regret and loss aversion have also been shown to influence investment selection. According to prospect theory, investors weigh losses twice as much

as gains of a similar magnitude and thus will attempt to avoid the regret associated with a loss (Kahneman and Tversky , 1979, 1992; Shefrin, 2002).

As this brief in summary indicates behavioral finance can be divided into two broad lines of research both of which highlight the intersection of finance and psychology. One aspect of the behavioral finance literature explores irrationalities that are common to all investors. Example in this strain include: anchoring, representativeness, over confidence and the other biases discussed above. The second line of inquiry examines the differences between groups for example, sophisticated versus naive investors, and gender differences. This paper belongs to the second category of the behavioral finance literature.

This paper expands upon this strain of literature by examining how dyslexia, a specific learning disability which impacts a person's capacity to successfully interpret and perform both written and mathematical functions, is related to the risk perception and allocation decisions of afflicted individuals.

This preliminary study attempted to answer this question by comparing the results of a simulated 401(k) investment allocation exercise across a matched sample of dyslexic and mainstream subjects. Subjects were given "info sheets" for the asset allocation choices similar to those provided by a firm's HR department. The subjects were asked to judge the risk of each investment alternative and select their optimal asset allocation from the list provided. The main hypothesis being tested is that while dyslexics may be able to more

accurately estimate the risk of each investment alternative graphically, as a consequence of their assumed mathematical deficits, they should experience greater difficulty performing the calculations necessary to derive the optimal portfolio allocation and will thus resort to naïve diversification strategies.

1.1 Definition of Dyslexia and its Prevalence

Dyslexia is a specific learning disability that is neurobiological in origin. “It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling or decoding abilities.” (Lyon, 2003) There seems to be a common misconception that dyslexia only impacts a person’s ability to learn to read; however, this is not true. Kay and Yeo (2003) note that several of the cognitive features of dyslexia such as: working and long-term memory retrieval weakness, difficulty memorizing step-by-step procedures and, sequencing difficulties can affect peoples’ success in mathematics and therefore potentially their investment decisions. Dyslexics often experience difficulty memorizing number facts (such as multiplication tables) as well as correctly “doing math operations” (IDA fact sheet, 2008). While conservative estimates of the prevalence of dyslexia range between 3 and 6% of the general population (Singelton, 1999) the International Dyslexia Association believes that 15-20% of the worldwide population may be afflicted (IDA fact sheet, 2008).

In order to investigate how dyslexia is related to asset allocation, one must first establish how these decisions are made by the mainstream population. The

literature review in section 2 examines the decision making processes with respect to risk perception and asset allocation decisions. Section 3 describes the hypothesis development by highlighting the potential differences between the risk perception and asset allocation decision-making process of dyslexics as compared to the mainstream population. Section 4 outlines the data collection and study design. Section 5 describes the results. Section 6 presents the conclusions and interpretations of the study and section 7 outlines possible extensions.

2. Literature Review

2.1 Problem Solving Methodologies

According to Vessey (1991), all problems can be broken into three components: the problem presentation, the problem solving task and mental representation. Problem presentation is the format in which the information is presented to the individual. The problem solving task is the question which the individual seeks to resolve. The mental representation is the way that the problem is conceptualized in the subject's working memory as a function of both the problem representation and task. For the purposes of this essay, the problem presentation refers to the format of the financial data. The problem solving task is to analyze the risk of the asset in question to determine whether or not one wishes to invest.

Once one has identified the problem, in our case whether or not to undertake an investment opportunity, he or she must determine which problem solving methodology to employ. Vessey (1991) describes the two basic problem solving methodologies: perceptual and analytical. The perceptual or holistic approach to problem solving is based on the idea that subjects examine the entire problem directly rather than explicitly examining each element (Amer, 1991). This approach allows the subject to make associations based on perceived relationships in the data (Vessey, 1991). Conversely, a subject using an analytic or linear problem solving methodology would begin by decomposing the problem into its component parts and examining each sequentially (Amer, 1991). This

information processing strategy requires subjects to extract discrete values which are then used in computational data analysis (Vessey, 1991).

Financial data are commonly presented either in graphic or tabular form. Normally graphs illustrate trends in performance, while actual performance statistics, such as accounting statements, are reported in tabular form. A good deal of research has been conducted on the impact that data representation has on the problem solving methodology employed. Vessey (1991) explicitly distinguishes between judgment and choice. As he explains it, judgment requires the subject to make a decision concerning a number of alternatives in a set while choice requires one to select the most preferable alternative. With respect to financial decisions, risk perception is a judgment while asset allocation is a choice. Rosen and Rosenkoetter (1976) show that as a consequence of this division, judgments tend to result from a holistic approach whereas choices result from an analytical process. This finding implies that while subjects derive their risk perceptions by examining trends in performance, their actual asset allocation decisions are more likely to stem from direct data analysis.

2.2 The Impact of Data Presentation Formats

We have all heard the expression, “a picture is worth a thousand words”. To this end Larkin and Simon (1987) document that graphs emphasize the relationships between data points because they preserve the geometric and topological relations of the data. Briggs et al. (1988) argue that graphical representations

are preferable for tasks which require spatial reasoning such as looking for patterns in data. It has also been shown that graphs are preferable for summarizing data, showing trends and relationships over time and detecting deviations in the data (Jarvenpaa and Dickson, 1988). On the other hand, tabular based representations are superior for symbolic tasks which require data extraction and calculation (Vessey and Galletta, 1991). Since tables are symbolic representations of discrete data, they facilitate the analytical processes (Vessey, 1991). Taking these findings into account, it has been theorized that graphical representations should be preferable for depicting spatial data and making judgments (i.e. risk perception), while tabular representations should be superior for tasks involving symbolic logic where the subject is required to make a choice (i.e. asset allocation). This is the essence of the theory of cognitive fit proposed by Vessey (1991).

The theory of cognitive fit argues that the method by which information is presented to a subject can influence the way that this information is processed. According to this theory the individual problem solvers' information processing is more efficient and effective when they are able to employ the appropriate mental representations (i.e. graphs for spatial tasks and tables for symbolic tasks). Empirical tests of this theory have had mixed results. Amer (1991) examines the impact of graphical vs. tabular data representations on a subject's ability to determine whether a firm had violated its debt covenant (a choice). The subjects were given information concerning the firm's debt position, size, liquidity,

earnings and interest coverage presented in tabular and 3 different graphical representations: bar graphs, polygon display and facial simulation. He found significantly different decision accuracy across the different data representations with the polygon and face graphics producing the worst results. In a similar study conducted by Frownfelter-Lohrke (1998), subjects were asked to predict the firm's financial position in the coming year (a spatial task), as well as forecast the firm's EPS in the following year (a symbolic task) using graphic, tabular and combined data. Her findings do not support the theory of cognitive fit with regard to decision accuracy; however, both of these decisions can be classified as judgments and her results do show that the graphical group completed the spatial task fastest while the tabular group completed the symbolic task slowest as one would predict when examining the tasks from a judgment/choice perspective.

2.3 Risk Perception

As discussed above, people derive their risk perceptions by examining trends in performance; therefore, visual biases which influence the interpretation of trends should impact a subject's risk perception. Raghubir and Das (2003) investigate whether people exhibit biases when examining stock information in graphic form. They hypothesize that people sample the local maxima and minima of a series and use this as a source of information to make investment related judgments. Because stocks with longer (shorter) runs have higher (lower) maxima and lower (higher) minima they are perceived as being more risky. The use of an

information source as a tool for making a judgment depends on the presence and "diagnosticity" of alternative information sources (Feldman and Lynch, 1988). Local maxima and minima is one source of information a person can use to judge the overall return and risk of a stock. If local maxima (minima) are over-sampled relative to local minima (maxima) the trend line would be biased upward (downward) causing the subject to increase (decrease) the perception of the risk. Consistent with this idea, Raghubir and Das (2003) find that stocks with longer runs are perceived as riskier.

Behavioral biases have also been shown to impact risk perception. Koonce et al. (2004) hypothesize that investors view risk as a function of both behavioral and statistical based components. They propose that individuals judge the risk of financial items by considering both the likelihood of positive and negative outcomes as well as their degree of worry and controllability. Their study focuses specifically on the impacts of potential loss outcomes, and Slovic's measures of dread and the unknown. The potential loss outcome refers to the range of possible losses. Higher (lower) potential loss outcomes lead to greater (lesser) perceived risk. According to Slovic (1987) risk perceptions are a function of "dread" and the "unknown". Dread captures the degree of control a person has over the item as well as the amount of worry and catastrophic potential associated with it, while the unknown refers to how well the item and/or its impact are understood by the subject. Koonce et al. (2004) found that subjects' quantified loss outcome expectations were influenced by their risk ratings

resulting from the dread and unknown measures. Specifically they note that the potential loss outcome has an indirect effect on perceived risk via its influence on the subject's feeling of dread associated with the financial item in question. Their results are robust to the use of either low context qualitative disclosures such as press releases and brokerage reports as well as more detailed reports such as SEC required filings.

Another commonly researched behavioral phenomena is the representative heuristic. The representative heuristic, as defined by Kahnemann and Tversky (1974) is the tendency for a subject to rely too heavily on stereotypes or "available" information when making decisions regardless of the size of the sample and, to seek out information that supports their point of view and discount information which runs contrary to it. With regards to financial decisions, these tendencies can lead people to infer that current short term trends will continue into the long term, ignoring the tendency for reversion to the mean, and often resulting in biased judgments. To illustrate this phenomenon, DeBont (1992) finds that long-term earnings forecasts by securities analysts tend to be biased in the direction of recent success.

2.3 Asset Allocation Decisions

Bodie and Crane (1997) present a list of commonly accepted investment principles promulgated by investment advisors and academics alike. They argue that funds saved for retirement should primarily be invested in equities and long

term fixed income securities. It is also suggested that investors diversify their total portfolio across asset classes with the equity portion diversified across industries and companies. With respect to age, they sight the popular adage that the proportion of peoples' equity holdings should be 100% minus their age. In general it is thought that the recommended fraction of equity holdings should increase with wealth and marital status (when both partners are employed) and decline with age. The commonly sighted argument for the equity-wealth relationship is that wealthier individuals are more capable of bearing the increased risk associated with equities (Agnew et al.,2003; Bodie and Crane, 1997; Bahandan and Deves, 2008). The marriage-equity relationship is based on the idea that married couples are able to shoulder the risk of equity holdings because they can diversify across labor market shocks (Bodie and Crane, 1997).

Based on a survey of 916 TIAA-CREFF members, Bodie and Crane (1997) find that age and net wealth do in fact impact equity holding as the theories suggest. A similar study by Agnew et al. (2003) supports these findings. Based on a study of trading activity of 6,778 401(k) plan participants, they find that equity allocations are higher among males, higher income, and married investors and lower among older investors. More recently, Bhandari and Deaves (2008) find that the stock-bond mix is impacted by gender, age and income with younger, higher earning males holding the largest proportion of equity. The age-equity relationship is studied by Ameriks and Zeldes (2001) who classify this relationship as non-monotonic, initially increasing then decreasing over an

individual's investment life cycle. Bhandari and Deaves (2008) argue that this relationship exists because while investors tend to decrease their equity holding as they age, they increase their equity exposure as they approach retirement because the returns associated with the higher risk of the equity increases their ability to retire sooner.

As discussed previously, mean-variance theory holds that investors should maximize their expected utility of wealth subject to a given level of risk tolerance. An efficient allocation is produced when investors construct a portfolio which produces the highest expected return for a given level of risk. According to this line of reasoning, an investor should not be concerned with the number of assets in his (her) portfolio, but rather its risk-return profile, as such, the fraction of equity funds offered should not affect the chosen allocation as long as the offerings are sufficiently diverse. However, Benartzi and Thaler (2001) show that when faced with a list of potential investment opportunities, their survey participants tended to naively diversify by simply dividing their contributions evenly across the offered funds i.e.: choose an allocation of 1/n where n= the total number of funds available. They document that, as a consequence of this tendency, the proportion of the investor's portfolio allocated toward stocks (bonds) is highly correlated with the number of equity (debt) offerings available and may thus result in investment choices which are more (less) risky then the subject intended[1]. More recently, Huberman and Jiang (2006) investigated this

[1] It should be noted that Benartzi and Thaler (2001) do not claim that the 1/n fund selection strategy is necessarily inefficient since the allocation may still lie on the efficient frontier.