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Managing a 401(k) account: An experiment on asset allocation

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Abstract

The study reports the results of an asset allocation experiment in which subjects managed an endowment of money over a 20 "year" time period. While grounded in theory, the study takes an applied look at the ability of subjects to efficiently and effectively make asset allocation decisions similar to those found in 401(k) accounts. The main conclusions are as follows. First, efficient portfolios are more easily created when the set of assets to choose from is carefully constructed. Thus, financial engineers should be given the responsibility for choosing the assets available to plan participants and ensuring that combinations of these assets will fall on the efficient frontier. If followed, this advice would likely significantly reduce the amount of individual company stock offered in Defined Contribution (DC) plans in place of well-constructed low cost index funds from multiple asset classes. Second, if the assets selected for inclusion in DC plans allow the investor to easily create portfolios on the efficient frontier, then the challenge for the investor is not how to get onto the frontier but where to locate on it. The simplistic surveys that are commonly used by DC plan providers to determine risk tolerance and to recommend asset allocations are woefully inadequate for this task. More sophisticated and theoretically driven instruments must be created to educate investors on the risks and the benefits available at different points along the efficient frontier.

JEL Classification: G11, G23

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Introduction

As recently as 1990, 62% of United States retirement assets were held in professionally managed accounts. By 2003, 51% of retirement assets were held in professionally managed accounts and 49%, or 5.8 trillion dollars, were individually managed (Investment Company Institute, 2004).[1] This trend will continue as employers have begun en masse to shift from defined benefit pension plans[2] to defined contribution plans.[3] According to the Bureau of Labor Statistics, the percentage of full-time employees in medium and large size establishments participating in defined benefit plans has fallen precipitously from 80% in 1985 to 36% in 2000. Adding to these trends is the ongoing national debate over Social Security reform and the various proposals to introduce privately managed accounts. Taken together it is clear that individuals are going to bear a much greater responsibility for their long term retirement investment decisions.

The bulk of individually managed employee retirement savings will likely be held in defined contribution (DC) pension plans. A typical employer sponsored DC plan, such as a 401(k) or 403(b) plan, is like a savings account into which the employer and the employee contribute a specified dollar amount or percentage of earnings into the account. The employee is given a choice of various investments such as stocks, bonds, mutual funds, company stock, cash, guaranteed investment contracts, and real estate investment

[1] Professionally managed accounts include state and local government pension plans, private defined benefit plans, federal pension plans, and annuities. Individually managed monies include IRAs and defined contribution pension plans.
[2] Under a defined benefit plan the employer agrees to the amount of the benefits to be paid and bears the responsibility to fund this liability. The employer makes the decisions on how to invest money to fund this liability and bears the risk of the performance resulting from these investment decisions.
[3] Under a defined contribution plan the employer agrees to contribute a specified amount toward employee retirement. The decision of how to invest that money, and the risk of the performance resulting from the investment decision is borne by the employee.

trusts. It is the employee's responsibility to both properly fund and manage this account which includes making appropriate asset allocation decisions. At retirement, the balance in the account forms the basis of the employee's retirement income. The employee will have various options on how and when to withdraw the savings, and will likely continue to manage and make investment decisions on the savings well into retirement.

Saving for retirement poses a number challenges for the individual investor. Mitchell and Utkus (2004) argue that the main problems individuals face in retirement planning can be organized around three decisions: 1) the decision to save; 2) the investment decision; and 3) the decumulation decision. In this paper we focus on the investment decision, and specifically, the type of repeated asset allocation decisions an investor must make in managing a typical 401(k) over a long period of time. The problem that we will focus on concerns how individuals choose to allocate their assets when the time horizon is long, such as the beginning of a career, and how asset allocations change as the time horizon shortens, such as when retirement nears. In so doing, we examine the effects that additional information regarding the projected value of the portfolio has on individuals' portfolio choices, an issue of importance from both theoretical and policy perspectives.

The rest of this paper is organized as follows. First, we review normative investment theory regarding how optimal asset allocations decisions should be made, followed by a summary of prescriptive asset allocation advice commonly offered by financial advisors. Next, a review of the behavioral finance literature is offered, focusing on results related to investors making long-term asset allocation decisions. We then present an experiment designed to assess how individuals make asset allocation decisions

–including the introduction of a manipulation designed to reduce myopic loss aversion. We conclude with a discussion, limitations, and directions for future research.

Literature Review

The Mean-Variance (MV) model[4] (Markowitz, 1959) is commonly used to describe optimal choice behavior in asset allocation decisions. Imagine an investor who wishes to allocate a certain amount of wealth today, *X*, among *n* different risky investment opportunities. Each of the *n* investment opportunities offers rates of return $R_1, \ldots, R_n$, which are assumed to be random variables with given joint probability distribution. If amount x_i, $i = 1, \ldots, n$, is the current wealth allocated to opportunity *i*, where $X = \sum_{i=1}^{n} x_i$, then the final wealth of the investor is a random variable *w* given by

$$w = \sum_{i=1}^{n} x_i (1 + R_i)$$

where R_i = the return on asset i.

The investor's problem is to select $x_1, \ldots, x_n$ so as to maximize $E\{U(w)\}$ where *U* is his or her utility function and *w* is the end-of-period wealth (Kroll, Levy, and & Rapoport, 1988a). In this problem, if the distribution of returns offered by the assets is *jointly normal*, then an investor's expected utility can be maximized by selecting the most efficient portfolio which is the best combination of mean and variance (Copeland and Weston, 1988). That is, an investor's expected utility is maximized if he or she selects an allocation of assets that provides the highest expected return for a given level of risk consistent with his or her preference for return and risk.

[4] The MV model implies that investors behave as if they had quadratic utility functions over the relevant range, or that returns are normally distributed.

The MV model prescribes the optimal asset allocation behavior for an investor who only cares about the mean and variance of portfolio returns over a single period. Campbell and Viceira (2002) provide a graphical representation of this analysis that is reproduced in Figure 1. The normative asset allocation advice offered from the MV analysis is straightforward and somewhat surprising. All investors who care only about the mean and standard deviation of portfolio returns will hold the same portfolio of risky assets, or the best mix of stocks and bonds (Tobin, 1958; Campbell and Viceira, 2002). All investors will create portfolios on the mean-variance efficient frontier, represented by the straight line in Figure 1, by holding the same optimal risky portfolio and/or cash. Conservative investors will hold large proportions of cash and locate on the lower left of the efficient frontier while aggressive investors may borrow to create leverage and locate on the upper right of the efficient frontier. No matter where on the frontier investors choose to locate, the mutual fund theorem of Tobin (1958) specifies that all investors will hold the same proportion of assets in the risky portfolio.

Insert Figure 1 about here

Applying the recommendations from the MV model to a typical DC plan participant is straightforward. First, a DC plan participant would decide on his or her risk tolerance and thus where on the efficient frontier to locate. Second, the optimal combination of the risky portfolio and cash would then be chosen. In practice, the risky portfolio would likely be constructed of broad based index funds.[5] While this approach

[5] An index is a portfolio of assets selected according to some established criteria. An index *fund* is a real mutual fund that buys assets, such as stocks or bonds, and holds them in a portfolio that approximates the index. The most widely followed index is the Standard and Poor's 500, and the best known index fund is the Vanguard 500 from The Vanguard Group which tracks the S&P 500

may not put the average investor exactly on the frontier, for practical purposes it is likely a close enough approximation. Since the MV analysis is a single period model, the investor would then presumably repeat these steps each period an asset allocation decision is to be made. But assuming the investor's risk preferences do not change, there would be little change in the asset allocation over time.

The recommendations of the MV model contrast with commonly proffered advice of investment professionals. A common practice of investment advisors is to recommend different asset allocations depending upon the length of the investment horizon. For example, one heuristic used is that the percentage of bonds in a portfolio should be equal to 1 – investor's age. Thus, a young employee with many years until retirement would be advised to choose an aggressive asset allocation strategy and overweight the portfolio with stocks. In contrast, an employee on the verge of retirement might be advised to allocate his portfolio more conservatively and overweight bonds and cash. The logic behind this advice rests on a time diversification argument. The time diversification principle states that portfolio risk decreases as the investment horizon increases (Jaggia & Thosar, 2000). But Samuelson (1969) showed that under certain conditions (stocks returns follow a random walk and investors exhibit constant relative risk aversion) the asset allocation decision should be independent of the time horizon. In contrast, Jaggia and Thosar (2000) have shown, using a modified utility function, that the time diversification argument can be supported.

While the above arguments relate to the question of how investors with long time horizons *should* allocate their assets, we now look at some of the research showing how

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(http://www.moneychimp.com/articles/index_funds/overview.htm).

investor *do* allocate their assets. A survey of the behavioral finance literature suggests that investors may be subject to several biases when allocating their portfolio over a long time horizon. In a series of papers Benartzi and Thaler (1995, 1999, 2001, & 2002) have identified several potential biases possibly influencing long-term asset allocation decisions. First is the "1/n strategy." Since many employees may not have the expertise required in making allocation decisions, the 1/n heuristic applied to a DC pension plan is to allocate the portfolio evenly across the different mutual funds offered within the plan. For example, if five different funds were offered in a 401(k) plan, an employee would allocate 20% to each. Examining the distribution of 401(k) account balances, Benartzi and Thaler (2001, p. 79) conclude: "Consistent with this naïve notion of diversification, we find that the proportion invested in stocks depends strongly on the proportion of stock funds in the plans".[6]

Another bias affecting asset allocation is myopic loss aversion (Benartzi and Thaler, 1995). Loss aversion (Kahneman and Tversky, 1979) implies that investors are more sensitive to losses than gains. Benartzi and Thaler (1999) suggest that a typical investor will psychologically weight a loss in wealth about twice as much as an equal gain in wealth. Myopia results from mental accounting and aggregation rules (Kahneman and Tversky, 1984; Thaler, 1985) which cause investors to aggregate gains and losses differently and to evaluate their portfolio too frequently. Investors will tend to avoid riskier (higher variance) investments if their time horizon in viewing those investments is short (myopic) because the losses over the short term will weigh more heavily on them then the gains. The result of myopic loss aversion is that long term investors will under-

[6] For empirical evidence showing mixed support of the 1/n strategy, see Rugh, 2003.

invest in riskier assets (namely stocks) compared to what would be consider optimal or rational.

Framing effects can also affect asset allocation. Benartzi and Thaler (1999) examined how university employees might allocate their pension assets contingent upon the presentation of historical asset returns. Utilizing a survey methodology and asking subjects to make hypothetical asset allocation decisions, the study manipulated the presentation of fund returns. One group was shown a graphical representation detailing the historical performance of stocks and bonds based upon *one-year* rates of return, while a second group was shown such results based upon hypothetically constructed *30-year* rates of return. The results show that when charts were constructed from the actual return data from 1926-1993, a period in which stocks outperformed bonds by about 6% annually,[7] subjects who saw the one-year rates of return were significantly less likely to invest in stocks compared to subjects who saw the 30-year rates of return. However, in an additional study in which the simulated return information was created using an equity premium of only 3% rather than 6%, there was no significant difference in the choice of funds between the subjects in the different conditions.

In summary, we propose two perspectives on the ability of average investors to make asset allocation decisions over the long term. On the one hand, the theoretical simplicity of the MV model suggests that it should not be a very difficult task for the average investor to create a reasonable efficient portfolio assuming the underlying assets to choose from are reasonably efficient. Probably the greater challenge with the MV approach for the average investor is figuring out one's risk tolerance and the desired

[7] The difference in the returns on stocks and bonds is referred to as the equity premium.

location on the efficient frontier. Thus, the MV perspective suggests the average investor should be able to reasonably and efficiently allocate his assets over a long time horizon.

On the other hand, the behavioral finance perspective (or the heuristics and biases perspective) suggests the average investor is likely to perform poorly in allocating assets over a long time horizon. The cause of this poor performance is systemic cognitive biases, such as myopic loss aversion, and cannot easily be overcome. This perspective suggests that investors will likely make numerous mistakes in their investment behavior leading to significantly suboptimal results.

We next introduce an experiment designed to broadly test these two perspectives and to examine how myopic loss aversion is affected by the presentation of future value calculations. The motivation for the experiment comes from the fact that prior empirical results on asset allocation decisions are primarily based upon survey methodologies or on examining account balances in pension accounts. We believe that an experimental investigation where control can be exerted on some of the critical determinants driving investors' behavior on asset allocation decisions allows for greater internal validity and permits a more explicit testing of specific behavioral hypotheses.

An Asset Allocation Task

The structure of the asset allocation task is designed to mimic the problem an individual might face in managing an endowment of money over a 20 year time horizon. To begin, a subject is given an endowment. Each "year," the subject must decide how to invest the endowment. The investment options in the experiment include Stocks, Bonds, and Cash. Stocks are represented the Standard and Poor's 500 Index, bonds are represented by 10 year United States Treasury note, and cash is represented by the one-month United States Treasury bill. A spreadsheet is used to facilitate the asset allocation decisions. A sample spreadsheet and an explanation of each column are provided in Table 1.

The asset allocation decision is made by the subject entering a number in the appropriate cell for the chosen investment. For example, if a subject decides to invest 50% of his funds in stocks for that year, he would enter 50 in the Asset Allocation Column for Stocks. The spreadsheet provides checks and error messages to insure that 100% of all monies are invested for a particular year. Once a subject is satisfied with their asset allocation decisions for a particular year, he or she would then click a "Final Decision" button on the spreadsheet. The actual return information for each investment for that year is then added to the spreadsheet and the subject's gain or loss for the year is calculated and displayed. The spreadsheet allows a subject to only enter data into the asset allocation cells for a particular year. All of the other cells are locked and if a subject attempts data entry into another cell then an error message appeared. In addition, the columns of the spreadsheets are color coded to ease reading of the information displayed.

Insert Table 1 about here

The base experimental task is kept quite simple. The only decision for the subject is the percentage of his or her portfolio to allocate to stocks, bonds and cash. The subject is required to make the asset allocation decision at the beginning of each year and the subject is given one piece of information to aid in creating the portfolio and that is the expected rate of return on the portfolio.

Experimental Manipulations

Two experimental manipulations are introduced to the asset allocation task. The first manipulation is motivated by the myopic loss aversion problem. The basic problem of myopic loss aversion is that investors do not adopt a long enough time horizon in their investment decision making and therefore under-invest in risky assets. As discussed earlier, Benartzi and Thaler (1999) found evidence the investors would increase the stock allocations if they were shown hypothetical 30 year stock returns rather than one-year returns. The presumed explanation for this result is that 30 year stock returns can reduce myopia by reducing the amount of perceived or experienced volatility and thus cause investors to hold riskier investments such as stocks.

We hypothesize that myopic loss aversion may be reduced by giving investors future value projections of their portfolios. Future value projections are commonly provided in the end of year retirement account statements sent out by mutual fund companies. A future value projection shows how much an investment will be worth after a certain amount of time and a given rate of return. Such calculations are used extensively in financial planning. For example, TIAA-CREF[8] provides its investors with

[8] TIAA-CREF is one of the largest financial services organizations in the U.S. and the largest retirement system in the world. TIAA-CREF is a retirement system for some 2 million staff members of over 8,000

future value income projection on their year end statements. The calculation will project for the investor what his retirement income will be, given his current level of saving and various annual rates of return. For example, an investor's statement might project that with annual contributions of $5,000 and 30 years until retirement, the income during the first year of retirement would be $16,000, $75,000, or $160,000 assuming constant annual investment returns of 3%, 9%, or 12% respectively, and 20 years in retirement.[9] The future value projections highlight the impact of compounded annual returns. We hypothesize that such projections will shift investors' attention from the short term to the long term by emphasizing the payoff that can be earned by accepting the increased volatility that comes with increased risk. Thus future value projections do not change an individual's perception of risk, but rather they focus attention on the payoff that comes from tolerating that risk.

To test this hypothesis, we introduce a future value calculation into the experimental task. As shown in Table 1, a future value projection for a subject is made each year by multiplying the current portfolio value by the expected rate of return, based upon the subject's asset allocation, while taking into account the number of years remaining until Year 20. The subject is told that "this calculation is built upon the expected rate of return which can be significantly higher or lower than the historical average. Depending upon the actual rate of return the ending portfolio value may be significantly higher or lower than the forecasted future value."

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colleges, universities, and related education and research institutions across the nation.

[9] To calculate these amounts, first calculate the value of the portfolio at retirement, and then calculate the amount of annual income assuming a standard annuity. The formula is: $\dfrac{C(1+i)^n}{\left[1-\frac{1}{(1+i)^m}\right]\Big/ i}$, where C = the annual contribution amount, i = constant annual rate of return, n = the number of years until retirement, and m = the number of years in retirement.

The second manipulation introduced into the experiment is to vary the asset returns for the 20 years of the experiment. The subject instructions stated that the returns in the experiment are "generated using the same historical distribution of annual returns" from 1926-2003. To achieve this result, the returns on the experimental assets were the actual market returns on each asset for a consecutive 20 year period drawn from the 1926-2003 time-frame. Since there are 78 years in this time frame, there are 59 possible 20-year return streams to select from. Three out of the 59 possible 20-year return streams were randomly selected. The three periods and the actual assets returns for each year are shown in Table 2. Note that Condition 1 and 2 differ by only two years; condition 1 data begins in 1972 and condition 2 begins in 1970. Also noteworthy is that the average return on stocks in condition 3 is 8.08%, well below the historical average of 12.3%. Varying the asset returns allows for a more comprehensive investigation of how gains and losses affect repeated asset allocation decisions. The experiment is thus a 2x3 design with six experimental conditions. Ten subjects participated in each condition.

Insert Table 2 about here

Experiment

Subjects were recruited through an advertisement sent out through the campus mail to all University of Nevada, Reno staff employees, a total of approximately 1,400 employees. The flyer stated that a subject could earn between $5.00 and $50.00 depending upon performance for participation in a one hour experiment on investment decision making. Sixty subjects signed up to participate in the experiment.

The experiment was conducted in the Nevada Experimental Economics Laboratory. The laboratory consists of twelve networked personal computer stations. Each station is separated by large partitions such that a subject cannot see the computer station of another subject. Upon arriving at the laboratory, each subject took a seat at a station and received a copy of the human subject consent form and condition instructions. After all subjects for the session arrived the experiment commenced.

The experiment began with the reading aloud of the consent form and instructions. After consent was obtained, each subject received a $5.00 show-up fee. Since the recruitment flyer stated that subjects would receive a minimum compensation of $5.00, the show-up fee was given to fulfill this promise. Subjects were then told that any further compensation in the experiment was contingent on their performance in an asset allocation task.

The procedure of the asset allocation task was then explained. Table 3 provides the information given to subjects regarding the potential return on the assets in the task. To explain the statistical information contained in the table the subjects were told: "Stocks – The annual return on Stocks has averaged 12% over the last 78 years. One year the return on Stocks was as high as 53% and another year as low as (negative) -44%. The majority of the annual returns on Stocks fell within one standard deviation of the average, or between -8% and 32%." To explain how the actual returns would be generated in the experiment the subjects were told: "In this experiment the annual returns on Stocks, Bonds, and Cash will be generated using the same historical distribution of annual returns shown in Table 1. Thus, while past performance is no guarantee of future results, the annual returns on Stocks, Bonds, and Cash in this experiment will be similar to those produced over the last 78 years."

Insert Table 3 about here

After all the instructions were read and questions answered, the subjects then made allocation decisions for two practice periods. The subjects could then ask any remaining questions answered prior to beginning. Each subject then proceeded at his or her own pace in making the asset allocation decisions for the 20 years. Most subjects took approximately twenty five minutes to make all of their decisions. After all the decisions were completed, each subject filled out a short questionnaire and a receipt documenting their earnings. Each subject then walked to the front of the room where they were paid individually and anonymously in cash for their performance, thanked, and dismissed from the laboratory.

Results

The results section is organized as follows. We begin by describing the demographics of subject population and their self reported knowledge and experience with investing. Next, the data is analyzed at the aggregate level to describe the mean characteristics of the portfolios created. The subject portfolios are then plotted on the efficient frontier for the assets available in the experiment. ANOVA models are used to test for between subject differences across the experimental conditions. Regression models are then presented to explain the variables impacting the construction of portfolios. We conclude with an analysis of a survey questionnaire that subjects filled out at the end of the experiment.

Sample Demographics Sixty subjects participated in the asset allocation task. The population ranged in age from 20 to 63, the mean age is 38.5 years with 16 subjects under the age of 25 and 35 subjects over the age of 35.[10] Sixty six percent of the population is female, 48% reported having investments in a defined benefit plan, 34% reported having investments in a defined contribution plan, and 36% indicated they had an IRA account separate from their employer.[11] Sixty three percent of the subjects are employed at the University and 39% are students. The mean response to the question "How much experience do you have in making investment decisions similar to those in this experiment" is 3.42 on a 7 point Likert scale.

Mean Portfolios - The mean percentage allocation to stocks, bonds and cash and the associated standard deviations across subjects and years are shown in Figure 2 and Table 4. Across subjects the mean asset allocation is 51% stocks, 27% bonds, and 22% cash (please refer to Table 5). Forty three percent of subjects (26/60) allocated between 40% and 60% of their portfolio to the stock fund. The most frequent allocation to the bond fund is between 25% and 45%, and 10% to 35% is the most frequent cash allocation. Thirteen percent of subjects (8/60) allocated more than 75% to stocks. These stock allocations are roughly consistent with results reported by TIAA-CREF.[12] From 1992-

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[10] One subject did not complete the survey completed administered after the asset allocation task.
[11] The University of Nevada, Reno has both a defined benefit and defined contribution plan. The defined benefit plan is primarily for classified employees, whereas most faculty are covered by a defined contribution plan.
[12] Since TIAA-CREF funds are primarily from university employees and since our sample of subjects is primarily university employees this seems a sensible comparison.

2002, the average equity asset allocation in TIAA-CREF funds ranged between 38% and 62%; similarly, between 1986 and 2002 approximately 24% of TIAA-CREF participants chose to allocate more than 75% of their new allocations to equities (Rugh, 2003).[13]

Insert Table 4 and 5 about here

Insert Figure 2 about here

Most subjects allocated significantly more of their money to stocks than to bonds or cash. The average ratio of stocks to bonds is calculated for each subject and shown in the last column of Table 5. Only 8 of 60 subjects (13%) allocated more to bonds than stocks. Thirty seven percent of subjects allocated at least twice as much to stocks than bonds. These results are not consistent with the 1/n naïve diversification strategy reported by Benartzi and Thaler (2001). Subjects clearly did not choose to allocate their money 1/3, 1/3, 1/3 to stocks, bonds, and cash. The results are also not consistent with CAPM predictions that all investors will hold the same proportion of stocks to bonds.

As seen in Figure 2 there is no significant change in allocations across time. Recall that the time diversification argument suggests that as the time horizon shortens asset allocations will become more conservative. While there are no clear trends across subjects we will test these hypotheses at the individual level.

[13] In 2002, employees contributing to TIAA-CREF funds allocated 50.5% to stock funds, 32.8% to guaranteed or annuity contracts, 13.2% to fixed income funds which includes both bonds and cash, and 3.5% to real estate funds.

Efficient Frontier - Individual subject portfolios are next described by their expected return and standard deviation. Figure 3 shows the efficient frontier for the three assets used in this experiment.[14] The efficient frontier is the *efficient set* of portfolios. Each portfolio in this set is the best combination of expected return and standard deviation given the underlying assets available. The portfolio with the highest expected return of 12.3% requires a 100% asset allocation to stocks and has a portfolio standard deviation of 20.3%. The portfolio with the lowest standard deviation of 3.1% requires an asset allocation of 2% stocks, 2% bonds, and 96% cash and has an expected return of 4.1%. Note that there is no true risk-free asset available in this experiment and hence the efficient frontier does not intersect with the vertical axis (please refer to Figure 3 below).

Insert Figure 3 about here

Figure 4 plots all of the subject portfolios onto the efficient frontier. As expected, given the assets used in the experiment, the subject portfolios generally fall quite close to the efficient frontier. For example, in year 1 Subject 1 held a portfolio of 80% stocks, 10% bonds, and 10% cash. The expected return on this portfolio is 10.80% and the standard deviation is 16.38%. There is a portfolio on the efficient frontier that provides an expected return of 10.83% with a standard deviation of 16.27%. There are a few

[14] The efficient frontier shown was estimated by constructing every possible three asset portfolio, assuming one percent increments in asset allocations, and then finding the best asset allocations to provide the highest portfolio expected return for a given level of portfolio variance. Portfolio expected return is the weighted average of the expected return on individual assets. Portfolio variance is a weighted sum of variance and covariance terms and for a three asset portfolio can be written as: $w_1^2VAR(R_1) + w_2^2VAR(R_2) + w_3^2VAR(R_3) + 2w_1 w_2COV(R_1, R_2) + 2w_1 w_3COV(R_1, R_3) + 2w_2 w_3COV(R_2, R_3)$ (Copeland and Weston, 1988). The data set used consisted of the annual returns on the S&P 500, 10-year United States Treasury Bonds, and one-month United States Treasury Bills from 1926 to 2003.

portfolios with expected returns between 5-7% that are relatively inefficient, suggesting that there is room for improvement in the choice set of assets made available to the subjects. The graph also shows that subject portfolios were spread out across the entire range of the frontier, but with strong clustering in the lower to middle end of the frontier.

Insert Figure 4 about here

Between Subject Differences - The base question is whether subjects in the different experimental conditions constructed significantly different portfolios. To test for differences between subjects the General Linear Model is used. Since a portfolio of three assets can be described by either the expected return or the standard deviation of the portfolio, we run the models with these two different dependent variables. Three classification variables are included in the model: 1) whether the subject received the year 20 future value calculations (FV or NFV); 2) which historical return stream did the subject experience (RS1972, RS1970, RS1960); and 3) the interaction effect of these two variables. The results are shown in Table 6 and Figure 5. With either portfolio expected return or portfolio standard deviation as the dependent variable, all three classification variables are significant. As seen in Figure 5, subjects who received the future value calculation created portfolios with higher expected return (and higher standard deviation) compared to subjects who did not receive this calculation. Subjects who experienced asset returns in the 1960-1979 time period also created portfolios with higher expected return.

Insert Table 6 about here

Insert Figure 5 about here

The average allocations to stocks, bonds and cash in the different experimental conditions are shown in Figure 6. In the FV condition the average allocation is 53% stocks, 24% bonds, and 23% cash, versus an allocation of 48% stocks, 30% bonds, and 22% cash in the NFV condition. On average subjects who received the future value calculations increased their allocation to stocks by 5% and decreased their allocation to bonds by 6%. On average subjects in the condition that received asset returns from 1960-1979 increased their allocations to stocks 8-10% and reduced their allocations to cash by a similar amount compared to subjects who experienced asset returns beginning in 1970 or 1972.

Insert Figure 6 about here

Variables Impacting Portfolio Construction - The next set of analyses attempts to explain the variables that significantly impact portfolio construction. Since a portfolio can be described based upon the expected return and standard deviation of the portfolio, and also based upon the underlying assets in the portfolio, a series of regressions were run. We begin with analyses using the expected return and standard deviation of the portfolio as the dependent variables. The set of explanatory variables used in the regression model are shown in Table 7 and included: a dummy for gender, an indicator for age, a self reported survey measure of risk tolerance, an indicator for the existence (or lack of) of information on the expected future value of the portfolio, a dummy variable for the last period (to capture potential reversals in behavior at the end of the horizon), a dummy for the last two periods (with a similar idea), a dummy for positive returns in the previous period (to capture the degree of inertia), a self-reported indicator of experience in dealing with stocks, and dummies to identify the return stream experimental condition (i.e. 1970, 1972, 1960). These variables can be classified into two main categories, as shown in Table 7.

Insert Table 7 about here

Given space limitations, we will only comment briefly on the results stemming from the regression exercises. The variables that came up statistically significant at the 5% level to explain both the expected return and the standard deviation of the portfolio were: gender, age, the existence of information of the expected future value of the portfolio, and the risk tolerance category indicator. In all those cases, the quantitative effect was positive and very small. Only one variable produced a negative effect (on both the expected return and the standard deviation of the portfolio): the dummy variable for positive returns in the previous period. Once again, the quantitative effect was very small (-0.01). All the remaining explanatory variables came up to be statistically insignificant. In conclusion, all but one of the demographic and dispositional factors played a statistically significant role in explaining both the expected return and the standard deviation of the portfolio (the exception being the self-reported experience indicator), but only two of the situational factors turned up to be statistically significant in accounting for the changes in the portfolio’s expected return and standard deviation: the dummy for existence of information on the future expected value of the portfolio and the dummy for positive returns in the previous period.

Using the findings from this first set of regressions a second set of regressions was run replacing the dependent variables of portfolio expected return and standard deviation with the proportion of stocks and bonds in the portfolio. Table 8 presents a summary of the variables used in these regressions.

Insert Table 8 about here

The first interesting finding is the influence of age. The indicator for age has a statistically significant, but quantitatively very small impact on the share of stocks in the portfolio (an increment of one year leads to a 0.4 of a percentage point increase). The effect is even smaller for the share of bonds (an increment of 1 year leads to a 0.16 of a percentage point increase). However, a more interesting finding is connected to the influence of a dummy variable reflecting the behavior of the people over 40 years of age. In that case, the influence is not only statistically significant at the 1% level for both stocks and bonds, but also very strong quantitatively; people 40 or older hold, on average, 8 extra percentage points of their portfolios in the form of stocks. The effect is less quantitatively strong in the case of bonds, but still important: 40+ people hold 4.5 extra percentage points of their portfolio in the form of bonds relative to people in the 40- group. Figure 7 below summarizes the findings on the influence of being over 40 on the percentage of stocks held in the portfolio.

Insert Figure 7 about here

A second interesting finding is connected to the value of information regarding the future expected value of the portfolio. In this case, the effect was statistically significant at the 1% level for both the share of stocks and bonds, but the quantitative effect, though strong in both cases, had the opposite sign: positive for stocks, negative for bonds. Providing information on the future expected value of the portfolio raises the share of stocks by some 5 to 7 percentage points (depending on the composition of the vector of explanatory variables) and it reduces the share of bonds in the portfolio by a very similar amount.

Other interesting regression findings included: 1) an increase in the self reported risk tolerance level led to an increase in the percentage of stock held in the portfolio; 2) there was a negative correlation between self reported investment experience and the percentage of stock in the portfolio; and 3) a positive return of stocks in the previous year decreased the holdings of stocks in the typical portfolio by some 6 percentage points. Readers interested in these results are asked to contact the authors directly.

Questionnaire Results - At the conclusion of the asset allocation task the subjects were asked to fill out a questionnaire. In addition to collecting basic demographic information, the subjects were asked all the questions on the TIAA-CREF Risk Questionnaire. The questionnaire is contained in Appendix 1. Subjects responded to six questions designed to ascertain their attitude toward risk, their desire for high investment returns, their attitude toward investment gains and losses, and which of several investments they would be most comfortable with. The scoring guidelines for the Risk Questionnaire given by

TIAA-CREF indicate that if the summation of the responses on the six questions is between 0-26 then the respondent would probably prefer a *conservative* portfolio, responses from 27-48 suggest a *moderately conservative* portfolio, responses from 49-70 suggest a *moderately aggressive* portfolio, and responses from 71-100 suggest an *aggressive* portfolio. As seen in Figure 8, the 54% of subjects in this experiment fell into the moderately aggressive category, 29% into the moderately conservative category, 14% into the aggressive category, and only 3% in the conservative category. While the survey responses were positively correlated with the expected return on a subject's portfolio ($r = 0.33$, $p < 0.01$), the strength of the relationship was relatively weak suggesting a weak relationship between a subject's attitude and behavior.

Insert Figure 8 about here

Discussion

The intent of this paper was to examine in an experimental framework how well subjects do in an asset allocation task, which is one important component in the management of one's retirement assets. The results of this research both confirm and deny some of the problems that are thought to confound investors.

In this experiment most subjects tended to allocate the majority of their portfolios to stocks. Although there was some variance at the individual level, subjects generally invested twice as much in stocks compared to bonds or cash. Given the historical returns of the assets used in this experiment, this finding is consistent with reasonable investment behavior. The subjects clearly understood that stocks had outperformed other asset classes over the last 78 years and thus are a good investment choice. There was no evidence to confirm the naïve diversification theory since subjects did not blindly allocate 1/3 of their portfolio to each asset.

Subjects in the experiment tended to pick an allocation policy early on and stick with it. This finding is contrasted with the evidence that once most employees make their initial allocation decision in a defined contribution plan they rarely make any changes in their account. There is an important distinction to be made regarding the effects of these inertia decisions. An investor who never changes his allocation policy but must annually choose how to allocate his entire portfolio will always end up with a portfolio allocation equal to his policy. In contrast, an investor who makes an initial allocation decision but never rebalances the account will end up with a portfolio that is more heavily weighted in the best performing asset class. A question for future research is whether defined contribution plan participants understand this distinction. It may be that when investors make their initial asset allocation decision they naively believe that their account will automatically remain at this allocation. A simple remedy to this problem is to give investors the choice to have their accounts automatically rebalanced to their initial allocation decision on some set time schedule.

Subjects did not lower their allocations to stocks as the end of the exercise approached. This finding is consistent with the theories of Samuelson (1989) that investors should be willing to hold the same portfolio across time. These results are inconsistent with the time diversification argument since the subjects did not significantly change their allocations as the end of the investment horizon approached.

Another important aspect of this experiment was to assess whether giving subjects future value information would alter asset allocation. Subjects in the condition that received future value calculations did allocate more (about 5%) to stocks than subjects who did not receive such information. While the reason for this finding is debatable, the following explanation is offered. It is likely that most individuals do not appreciate the power of compounding and the effect that it can have on long term investments. Thus when subjects are given a future value calculation they come to appreciate how small changes in expected return can lead to large increases in end states of wealth. But subjects are also aware that additional expected return comes with additional risk. The future value information combines with a subject's preference for risk and leads to small adjustments in allocation policy.

The efficiency of subjects' portfolios was quite high. This was likely a result of the fact that almost any combination of the assets used in this experiment results in an efficient portfolio. But this finding is important on another level. It would be naïve to think that the average investor has an appreciation of the MV problem and the elegant solution provided by the efficient frontier. But the fact that subjects did create portfolios on the frontier suggests that with proper financial engineering the investors' burden can be greatly reduced. And this leads to our final point.

It is reasonable to expect that professional money managers will outperform the average individual managing his or her own portfolio. That being true, it is reasonable to expect that professionally managed DB plans will outperform individually managed DC plans. In fact, some research suggests that the gap between returns in DB and DC plans may be as high as 2% annually (Waring, Siegel, & Kohn, 2004). If employers and government pension provides are going to continue the shift away from DB plans and into DC plans, then the challenge is to financially engineer DC pension plans to minimize the negative impacts on investors. Along those lines, three results from this experiment are relevant.

First, efficient portfolios are more easily created when the set of assets to choose from is carefully constructed. Thus, financial engineers should be given the responsibility for choosing the assets available to plan participants and ensuring that combinations of these assets will fall on the efficient frontier. If followed, this advice would likely significantly reduce the amount of individual company stock offered in DC plans in place of well-constructed low cost index funds from multiple asset classes.

Second, if the assets selected for inclusion in DC plans allow the investor to easily create portfolios on the efficient frontier, then the challenge for the investor is not how to get onto the frontier but where to locate on the frontier. The simplistic surveys that are commonly used by DC plan providers to determine risk tolerance and to recommend asset allocations are woefully inadequate for this task. More sophisticated and theoretically driven instruments must be created to educate investors on the risks and the benefits available at different points along the efficient frontier.

Finally, our results suggest additional avenues for research in behavioral finance. Further basic research is necessary to explore and better explain why future value information affects asset allocation. We believe the result is connected to the causes of myopic loss aversion but there may be alternative explanations. Additional applied research is necessary to develop instruments to measure risk tolerance and to locate investors on the efficient frontier. And finally, more research is necessary to explain why subjects over 40 years of age held higher concentrations of stock than younger investors.

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Appendix 1

End of Experiment Questionairre

TITLE OF STUDY: An Asset Allocation Experiment
INVESTIGATORS: *James Sundali,Ph.D. 784-6993 x 317*
Rahul Bhargava, Ph.D. 784-6993 x 304
PROTOCOL NUMBER: SB03/04-65

Please circle or mark the appropriate box.

1. Gender: Female_____ Male_____

2. Age:______

3. Are you:

   a. UNR Faculty/Staff: Yes____ No_____

   b. UNR Student: Yes____ No_____

4. Do you currently have investments in:

   a. A defined benefit pension plan such as Nevada Public Employees Retirement System (PERS)

      Yes____ No_____

   b. A defined contribution pension plan such as the UCCSN Defined Contribution Plan (TIAA-CREF) or a 401(k) plan from another employer.

      Yes____ No_____

   c. An Individual Retirement Account (IRA) separate from your employer?

      Yes____ No_____

5. How much experience do you have in making investment decisions similar to those in this experiment?

   1------------2------------3------------4------------5------------6------------7
   None at all Some A great deal

Please answer each of the next six questions and circle the number that best represents your opinion.

6. “Protecting the principal of my investment is more important than achieving significant growth.” Do you…

A.	Strongly Agree?	0
B.	Agree?	4
C.	Disagree?	11
D.	Strongly Disagree?	16

7. Which of the following three investment strategies best suits you?

A.	One that seeks to avoid loss	0
B.	One that has the potential for both moderate gain and moderate loss	9
C.	One that maximizes potential gain regardless of the potential for loss	18

8. Let’s assume you own a stock fund that has lost 15% of its value of the past year, despite previous years solid performance. The loss is consistent with the performance of similar funds during the past year. At this time would you

A.	Sell all of your fund shares?	0
B.	Sell some buT not all of your fund shares?	4
C.	Continue to hold all of your fund shares?	9
D.	Buy more shares to increase your investment in the fund?	12

9. Inflation can greatly reduce the real rate of return on your investments over time. Which of the following best describes how you feel about investment risk with respect to inflation?

A.	Minimal potential for loss, although my investment may only keep pace with inflation	0
B.	Moderate potential for loss and lower volatility in trying to exceed the rate of inflation	9
C.	Signficant potential for loss and high volatility in trying to greatly exceed the rate of inflation	18

10. Which of the following three descriptions of hypothetical investment portfolio returns over a one-year period are you most comfortable with?

A.	Portfolio A: a likely return of 6% and slight chance of losing value	0
B.	Portfolio B: a likely return of 10% and moderate chance of losing value	9
C.	Portfolio C: a likely return of 14% and a signficant chances of losing value	18

11. Which of the following hypothetical portfolio average annual returns over a three-year period are you most comfortable with? A portfolio with a average annual returns that are likely to fall between:

A.	0% and 10%	0
B.	-5% and 18%	9
C.	-10% and 26%	18

When you have finished, please leave this questionnaire on the desk.

Figure 1. Mean-standard deviation diagram (Campbell & Viceira, 2002)

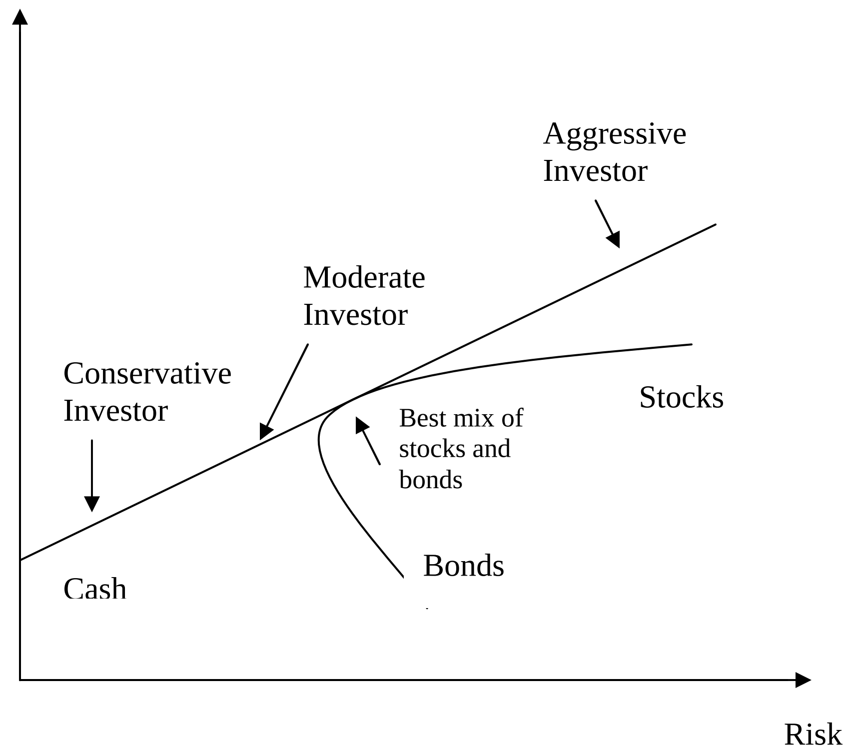


Table 1 – Spreadsheet Interface

			% Asset Allocation to:						Actual Annual % Return on:			
Year	**Beginning Account Balance ($)**	**Stocks**	**Bonds**	**Cash**	**Total % Allocation (100%)**	**Expected Rate of Return (%)**	***Year 20 Projected Value ($)***	**Stocks**	**Bonds**	**Cash**	**Annual Return ($)**	**Ending Account Balance ($)**
P1	$ 5.00	34	33	33	100%	7.3%	*$ 20.55*	10.0%	5.0%	4.0%	$ 0.32	$ 5.32
P2	$ 5.32	50	50	0	100%	9.0%	*$ 29.57*	-10.0%	-5.0%	3.0%	$ (0.40)	$ 4.92
1	$ 5.00	100	0	0	100%	12.3%	*$ 50.95*	3.9%	18.9%	6.5%	$ 0.20	$ 5.20
2	$ 5.20	0	100	0	100%	5.6%	*$ 14.65*	14.3%	11.2%	4.4%	$ 0.58	$ 5.78
3	$ 5.78	0	0	100	100%	3.9%	*$ 11.52*				$ -	$ 5.78
4					0%	0.0%	*$ -*				$ -	$ -
5					0%	0.0%	*$ -*				$ -	$ -

- **Year** – This column is the current period or year of the experiment. You will play two practice periods (P1 and P2) followed by 20 (1-20) years. You will not be paid for your decisions or the results of the practice period.

- **Beginning Account Balance** – This column keeps track of the amount of money you have at the beginning of each year. To begin the experiment you have been given an endowment of $5.00. The amount of money that you make or lose from your investment decisions each year will be added or subtracted from this balance.

- **% Asset Allocation to: Stocks/Bonds/Cash** – In these three columns you will enter the percentage of your beginning account balance (%) to invest in each of the investments. For example, if you wish to invest 33% of your money in Stocks, 34% in Bonds, and 33% in Cash, you will enter 33 in the Stock column, 34 in the Bond column, and 33 in the Cash column. The cells where you should enter your decisions are highlighted in yellow. These are the only three columns of the spreadsheet into which you will add data. *Note: To insure that your allocations have been entered in a cell, after you typed a number in a cell be sure to hit the "Enter" key.*

- **Total % Allocation (100%)** – This column checks to insure that that total amount of your allocations sums to 100%. If it does not, you will receive an error message asking you to correct your allocations.

- **Expected Portfolio Rate of Return**. Each year you will decide the percentage of your total money you want to invest in each of the three investments. As you enter your allocation decisions into the spreadsheet the program will calculate the "Expected Portfolio Rate of Return (%)" for that year.

    - The Expected Portfolio Rate of Return is based upon the *average* rate of return on each investment from the historical distribution. The average rate of return on Stocks is 11.0%, on Bonds is 8.3%, and on Cash is 6.2%. The Expected Portfolio Rate of Return is calculated by multiplying the average rate of return on an investment by the percentage of your portfolio allocated to this investment. For example, if you allocated 33%/ 34%/33% of your portfolio to Stocks/Bonds/Cash then the expected return on your portfolio is ((0.33*0.11) + (0.34*0.083) + (0.33*0.062)) = 8.5%.

    - Note that the expected rate of return on an investment is what the investment will return "on average." The actual return may be significantly higher or lower than this average.

- **Expected Year 20 Portfolio Value** – The spreadsheet will calculate the expected Year 20 portfolio value given your current year asset allocation decisions. This calculation is made by multiplying the current portfolio value by the expected rate of return while taking into account the number of years remaining until Year 20. The formula for this future value calculation is (Beginning Portfolio Value * (1 + Expected Annual Rate of Return)$^{\text{Number of Investment Years Remaining}}$).

    - Again, this calculation is built upon the expected rate of return which can be significantly higher or lower than the historical average. Depending upon the actual rate of return the ending portfolio value may be significantly higher or lower than the forecasted future value.

- **Actual Annual % Return on: Stocks/Bonds/Cash** – After you have made your asset allocation decisions and clicked the "Final Decision" button, the actual annual return for each of the investments will be shown.

- **Annual Return ($)** – This column displays how much money you made or lost for that year depending upon your beginning account balance (BAC), your asset allocations (AA), and the actual return (AR) on each investment. The calculation in this column is: (BAC * AA Stocks * AR Stock) + (BAC * AA Bonds * AR Bonds) + (BAC * AA Cash * AR Cash).

Table 2 – Asset Returns in Experiment

Condition 1				Condition 2				Condition 3			
Year	**S&P 500**	**T-BONDS 10 Year**	**T-BILLS**	**Year**	**S&P 500**	**T-BONDS 10 Year**	**T-BILLS**	**Year**	**S&P 500**	**T-BONDS 10 Year**	**T-BILLS**
1972	18.99%	2.39%	4.23%	1970	3.94%	18.92%	6.50%	1960	0.48%	11.21%	2.81%
1973	-14.69%	3.30%	7.29%	1971	14.30%	11.24%	4.36%	1961	26.81%	2.20%	2.40%
1974	-26.47%	4.00%	7.99%	1972	18.99%	2.39%	4.23%	1962	-8.78%	5.72%	2.82%
1975	37.23%	5.52%	5.87%	1973	-14.69%	3.30%	7.29%	1963	22.69%	1.79%	3.23%
1976	23.93%	15.56%	5.07%	1974	-26.47%	4.00%	7.99%	1964	16.36%	3.71%	3.62%
1977	-7.16%	0.38%	5.45%	1975	37.23%	5.52%	5.87%	1965	12.36%	0.93%	4.06%
1978	6.57%	-1.26%	7.64%	1976	23.93%	15.56%	5.07%	1966	-10.10%	5.12%	4.94%
1979	18.61%	1.26%	10.56%	1977	-7.16%	0.38%	5.45%	1967	23.94%	-2.86%	4.39%
1980	32.50%	-2.48%	12.10%	1978	6.57%	-1.26%	7.64%	1968	11.00%	2.25%	5.49%
1981	-4.92%	4.04%	14.60%	1979	18.61%	1.26%	10.56%	1969	-8.47%	-5.63%	6.90%
1982	21.55%	44.28%	10.94%	1980	32.50%	-2.48%	12.10%	1970	3.94%	18.92%	6.50%
1983	22.56%	1.29%	8.99%	1981	-4.92%	4.04%	14.60%	1971	14.30%	11.24%	4.36%
1984	6.27%	15.29%	9.90%	1982	21.55%	44.28%	10.94%	1972	18.99%	2.39%	4.23%
1985	31.73%	32.27%	7.71%	1983	22.56%	1.29%	8.99%	1973	-14.69%	3.30%	7.29%
1986	18.67%	22.39%	6.09%	1984	6.27%	15.29%	9.90%	1974	-26.47%	4.00%	7.99%
1987	5.25%	-3.03%	5.88%	1985	31.73%	32.27%	7.71%	1975	37.23%	5.52%	5.87%
1988	16.61%	6.84%	6.94%	1986	18.67%	22.39%	6.09%	1976	23.93%	15.56%	5.07%
1989	31.69%	18.54%	8.44%	1987	5.25%	-3.03%	5.88%	1977	-7.16%	0.38%	5.45%
1990	-3.10%	7.74%	7.69%	1988	16.61%	6.84%	6.94%	1978	6.57%	-1.26%	7.64%
1991	30.46%	19.36%	5.43%	1989	31.69%	18.54%	8.44%	1979	18.61%	1.26%	10.56%
Average	**13.31%**	**9.88%**	**7.94%**		**12.86%**	**10.04%**	**7.83%**		**8.08%**	**4.29%**	**5.28%**

Table 3 – Asset Return Information Given to Subjects

	Stocks*	Bonds**	Cash***
Average	12%	6%	4%
Standard Deviation	20%	9%	3%
Minimum	-44%	-8%	0%
Maximum	53%	44%	15%

*Stocks – Measured by the Standard & Poor's 500 Index. The S&P 500 is "Widely regarded as the best single gauge of the U.S. equities market, this world-renowned index includes a representative sample of 500 leading companies in leading industries of the U.S. economy. Although the S&P 500 focuses on the large-cap segment of the market, with over 80% coverage of U.S. equities, it is also an ideal proxy for the total market" (http://www2.standardandpoors.com).

**Bonds – Measured by the 10 year United States Treasury Note. "Treasury bills, notes, and bonds are marketable securities the U.S. government sells in order to pay off maturing debt and raise the cash needed to run the federal government. When you buy one of these securities, you are lending your money to the U.S. government" (http://www.publicdebt.treas.gov).

***Cash – Measured by the one-month United States Treasury Bill rate. "Treasury bills are short-term obligations issued with a term of one year or less" (http://www.publicdebt.treas.gov).

Figure 2. Mean Percentage Allocation to Stocks, Bonds and Cash by Year

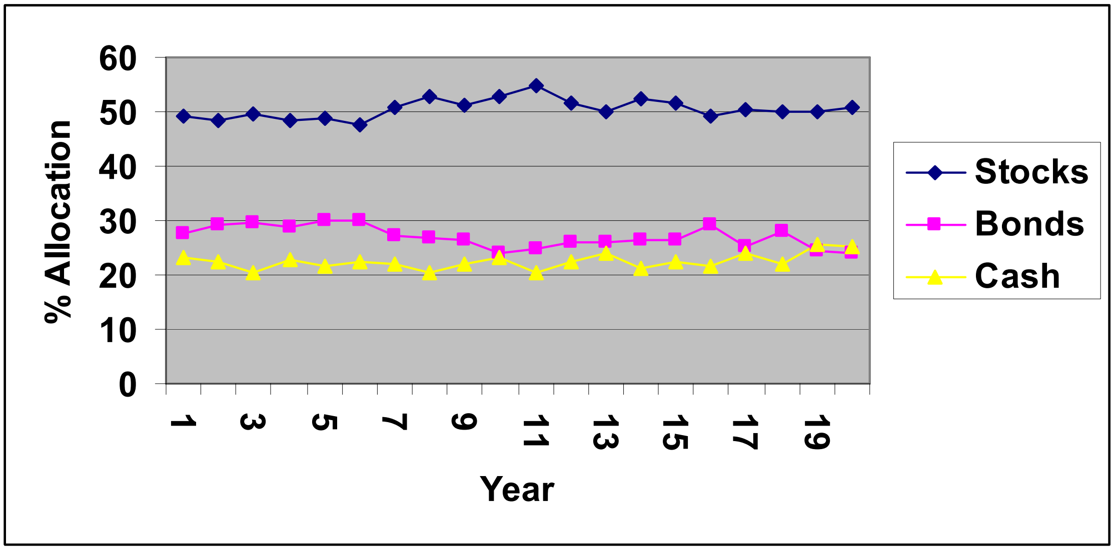


Table 4 – Mean Percentage Allocation to Stocks, Bonds and Cash by Year						
Year	Stock Mean	Stock STD	Bond Mean	Bond STD	Cash Mean	Cash STD
Practice1	51.0	22.5	28.7	13.8	20.3	15.7
Practice2	48.8	22.0	33.2	20.3	18.0	17.4
1	49.3	23.5	27.5	14.4	23.2	22.3
2	48.4	24.1	29.2	12.9	22.5	21.2
3	49.7	21.7	29.8	13.2	20.6	19.8
4	48.5	25.8	28.7	18.1	22.8	21.3
5	48.7	25.6	29.9	18.5	21.5	20.2
6	47.8	26.3	30.0	18.3	22.2	22.5
7	50.8	25.7	27.3	17.9	22.0	23.1
8	52.7	24.0	26.8	17.1	20.6	18.8
9	51.3	24.0	26.5	19.0	22.2	20.2
10	52.6	23.1	24.2	17.5	23.2	20.2
11	55.0	24.1	24.7	17.5	20.3	19.6
12	51.7	25.5	26.1	16.6	22.2	20.7
13	49.8	27.2	26.0	17.8	24.2	23.1
14	52.3	22.8	26.4	16.6	21.3	17.7
15	51.5	25.5	26.3	19.3	22.3	19.9
16	49.4	26.7	29.2	20.0	21.4	22.3
17	50.6	23.2	25.3	14.3	24.1	22.0
18	49.9	24.2	27.9	15.4	22.2	20.3
19	50.0	25.5	24.4	13.7	25.6	23.9
20	50.8	27.8	24.0	18.8	25.2	26.2

Table 5 – Average Asset Allocation by Subject across Years

	Average % Allocation to:			Ratio of Stocks/Bonds		Average % Allocation to:			Ratio o Stocks/Bo
Subject	Stocks	Bonds	Cash		Subject	Stocks	Bonds	Cash	
1	80	10	11	8.4	31	40	30	30	1.3
2	52	36	12	1.5	32	80	18	3	4.5
3	86	7	7	12.3	33	70	25	6	2.8
4	20	30	50	0.7	34	38	31	31	1.2
5	46	28	26	1.6	35	8	81	12	0.1
6	31	29	40	1.1	36	45	21	34	2.1
7	43	38	19	1.1	37	57	19	25	3.0
8	54	35	11	1.5	38	52	17	31	3.1
9	70	13	17	5.5	39	42	32	26	1.3
10	95	4	2	27.1	40	48	30	22	1.6
11	40	31	30	1.3	41	51	45	5	1.1
12	31	28	41	1.1	42	78	14	9	5.7
13	54	22	24	2.5	43	32	27	41	1.2
14	44	56	0	0.8	44	88	12	0	7.3
15	44	32	25	1.4	45	43	34	23	1.3
16	42	44	14	1.0	46	31	28	41	1.1
17	68	25	6	2.7	47	28	26	46	1.1
18	9	6	84	1.4	48	83	12	6	7.0
19	31	46	23	0.7	49	67	19	14	3.6
20	34	34	33	1.0	50	62	14	24	4.4
21	21	24	55	0.9	51	61	38	1	1.6
22	30	29	41	1.0	52	59	29	13	2.0
23	80	14	6	5.7	53	60	31	10	1.9
24	19	13	68	1.5	54	51	32	17	1.6
25	29	38	34	0.8	55	47	27	26	1.8
26	56	35	10	1.6	56	73	21	6	3.6
27	46	26	28	1.8	57	71	13	15	5.3
28	64	28	9	2.3	58	47	27	27	1.8
29	38	32	30	1.2	59	48	26	26	1.8
30	71	23	7	3.1	60	47	30	23	1.6
					Average	**51%**	**27%**	**22%**	**3.1**

Figure 3 – Efficient Frontier

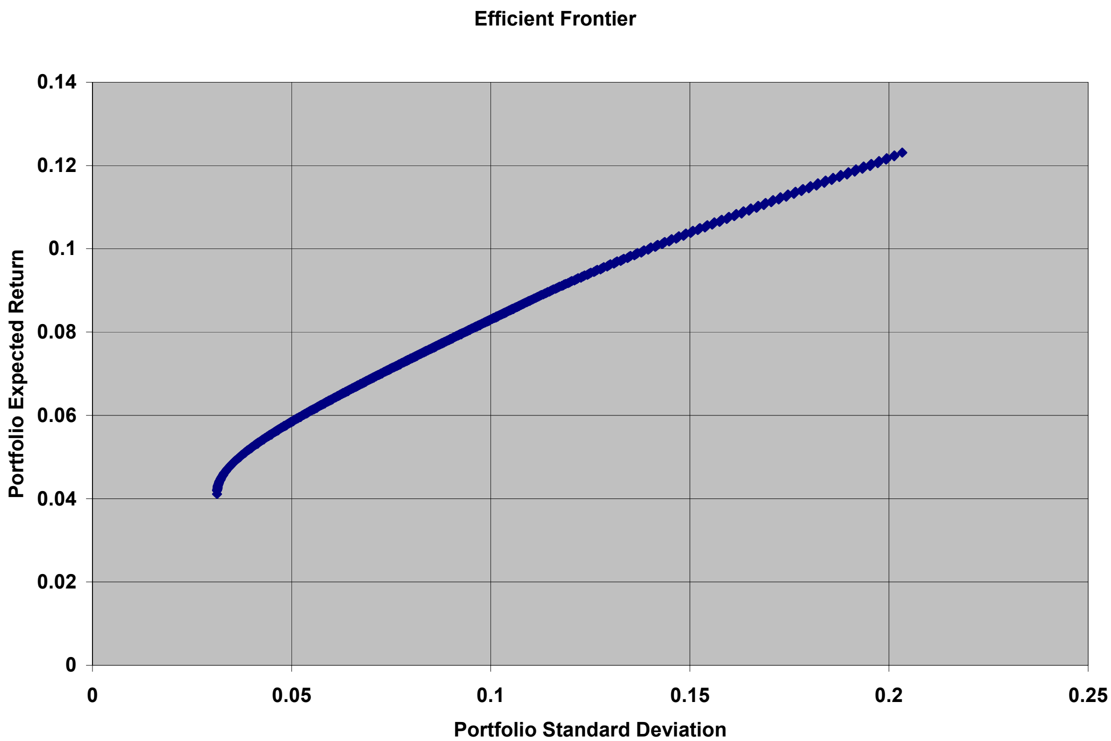


Figure 4 – Efficient Frontier with Subject Portfolios

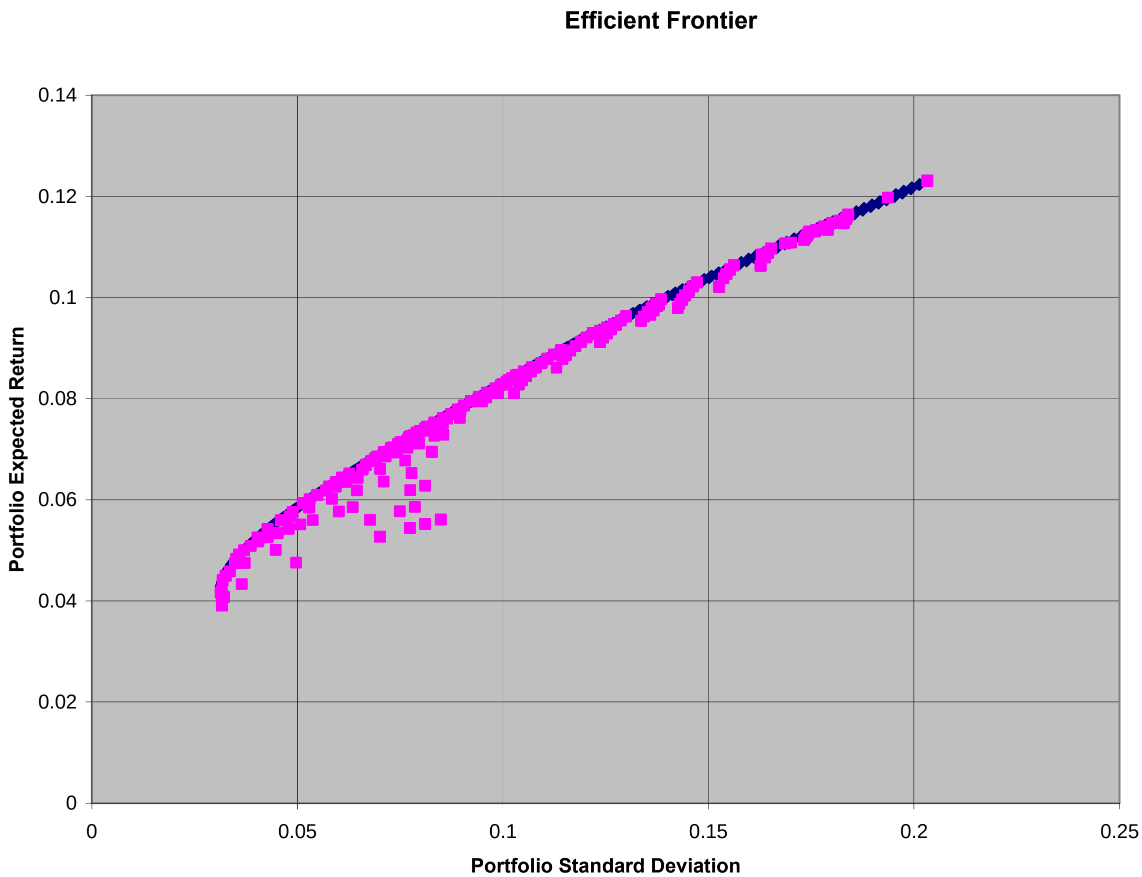


Table 6

Classification Variables	**DV = Expected Return**		**DV = Portfolio Standard Deviation**	
	F Value	*Pr > F*	*F Value*	*Pr > F*
Future Value	9.34	0.0023	10.61	0.0012
Return Stream	18.41	0.0001	15.80	0.0001
FV*RS	22.77	0.0001	29.51	0.0001

Figure 5

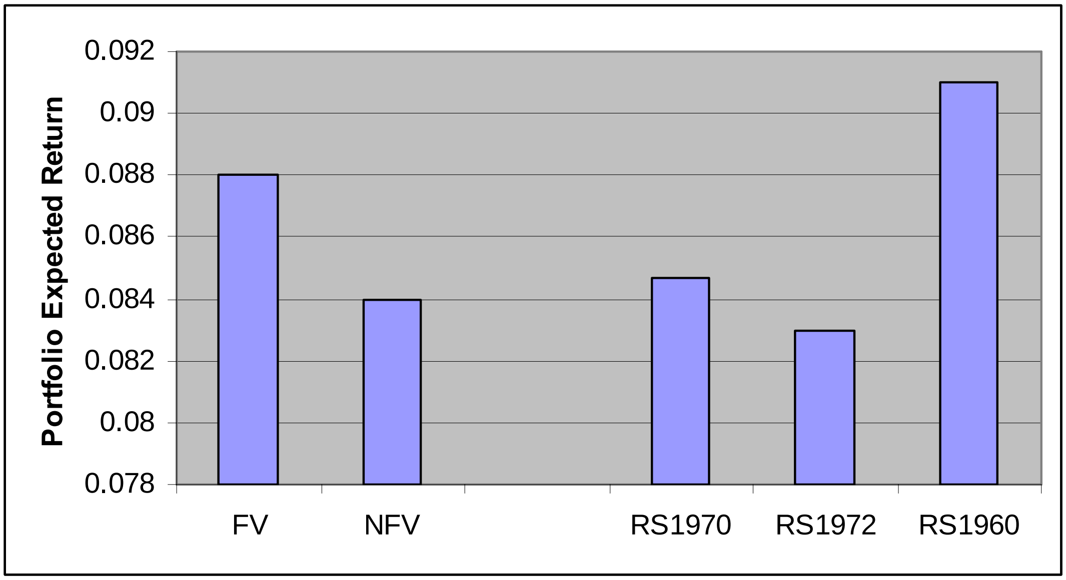
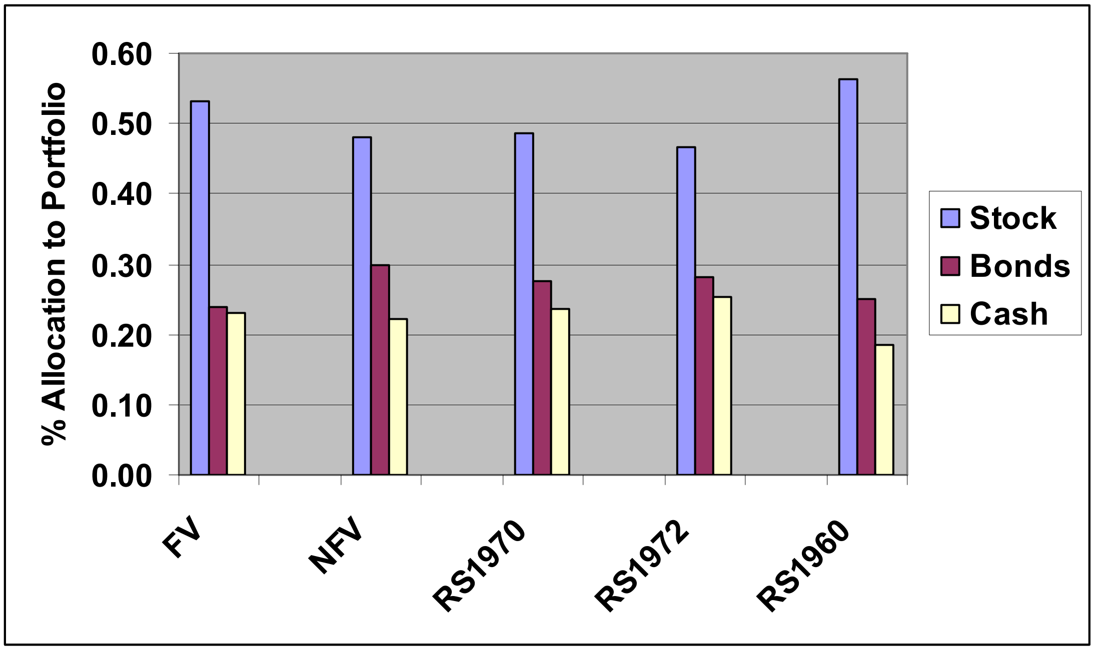

0.092
0.09
0.088
0.086
0.084
0.082
0.08
0.078
Portfolio Expected Return
FV
NFV
RS1970
RS1972
RS1960

Figure 6



0.60
0.50
0.40
0.30
0.20
0.10
0.00
% Allocation to Portfolio
FV
NFV
RS1970
RS1972
RS1960
Stock
Bonds
Cash

Table 7

<table>
<tr><td colspan="2">Dependent Variables:
Portfolio Expected Return
Portfolio STD</td></tr>
<tr><td colspan="2">Explanatory Variables</td></tr>
<tr><td>Demographic and Dispositional Factors</td><td>Situational Factors</td></tr>
<tr><td>Age
Gender
Self Reported Risk Aversion (Risk tolerance category indicator)
Self Reported Experience in dealing with stocks</td><td>FV Calculations
Return Stream (Block effects)
Last period effect dummy
Last two periods effect dummy
Previous period positive returns dummy</td></tr>
</table>

Table 8

<table>
<tr><td colspan="2">Dependent Variables:
• Share of stocks in the portfolio
• Share of bonds in the portfolio</td></tr>
<tr><td colspan="2">Explanatory Variables</td></tr>
<tr><td>Demographic and Dispositional Factors</td><td>Situational Factors</td></tr>
<tr><td>• Age
• Dummy for people 40 and over
• Gender
• Self Reported Risk Aversion (Risk tolerance category indicator)
• Self Reported Experience in dealing with stocks</td><td>• FV Calculations
• Return Stream (Block effects)
• Last period effect dummy
• Last two periods effect dummy
• Previous period positive returns dummy</td></tr>
</table>

Figure 7

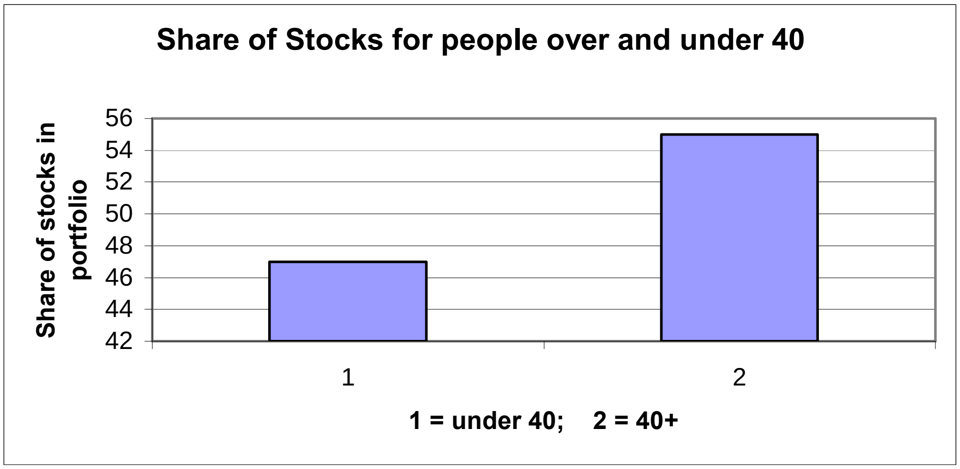
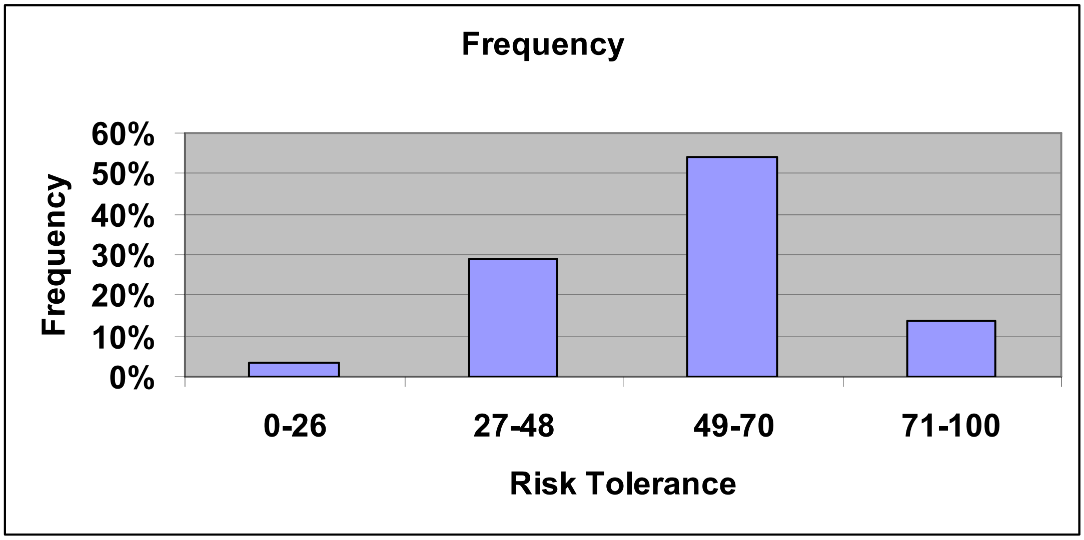
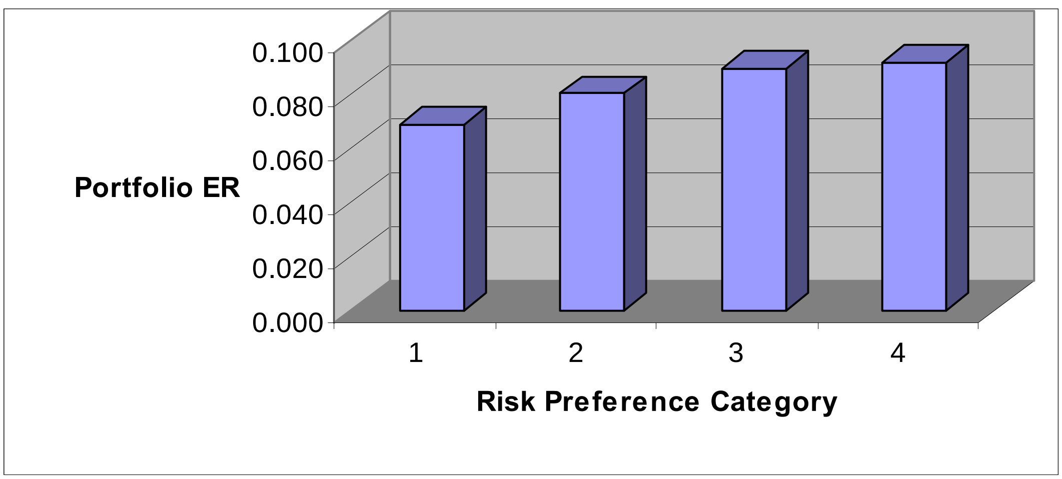

Share of Stocks for people over and under 40
Share of stocks in portfolio
56
54
52
50
48
46
44
42
1
2
1 = under 40; 2 = 40+

Figure 8


Frequency
Frequency
60%
50%
40%
30%
20%
10%
0%
0-26
27-48
49-70
71-100
Risk Tolerance


0.100
0.080
0.060
0.040
0.020
0.000
Portfolio ER
1
2
3
4
Risk Preference Category