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THE IMPACT OF ASSET ALLOCATION IN RETIREMENT PLANNING

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ABSTRACT

Due to the deterioration of guaranteed retirement income through defined benefit plans, the uncertainty of the future of social security, and increasing life expectancy, retirement planning is now more important than ever. The purpose of this paper is to determine how much an individual needs in order to retire, and to compare the results of different asset allocation strategies. There are many factors which we must account for in order to determine this number. These factors include the pre-retirement level of income, expected retirement age, retirement duration, buying an annuity vs. managing one's own funds, and the allocation of funds. This study will use stochastic projections to model the amount of money available at retirement and the amount needed to buy an annuity which can maintain the desired standard of living. Furthermore, the effects of length of employment and the timing of asset allocation will also be analyzed. In order to retire comfortably, it is essential to define retirement goals and make plans to achieve them. Choosing the correct asset allocation strategy could mean the difference between an enjoyable and an underfunded retirement.

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Chapter 1

Introduction

Retirement is one of the most significant events in a person's life. It is a point in time when an individual decides to leave the workforce and stop employment. Full retirement (ceasing to work completely in old age) is more widespread in first-world countries. In the United States, the normal age of retirement has traditionally been set at 65 years old. However due to a combination of recent economic, social, and political reasons, many workers are now forced to work longer in order to afford retirement. According to socialsecurity.gov, the normal retirement age in order to receive full eligibility for social security is now set at 67 and is predicted to increase ("Normal Retirement Age"). In light of these changes, retirement income and asset management are now more important than ever.

With this in mind, these changes have influenced individuals in all tiers of society. For example, policymakers want to ensure that retirees have a reliable safety net, but at the same time they are worried about how the aging population will affect these programs. In fact, many of the so called "baby boomers", a generation of people born in the mid 1900's during a temporary increase in birthrate, are approaching retirement age. This will place added strain on the already uncertain future of social security. Furthermore, employers are concerned about the welfare of their workers, particularly whether or not the current benefit programs are adequate for retirement. Guaranteed benefits, once offered by a majority of American companies, have been on a tremendous decline in the past few decades. According to workforce.com, in 1998 "90 percent of Fortune 100 companies offered the plans to new salaried employees" compared to only 30 percent in 2012 (Geisel). Taking the place of defined benefit plans are defined contribution

plans which often give the employee the ability to allocate their investments, while also placing the financial risk on their shoulders. Consequently a majority of working individuals, especially those who are now approaching retirement age, will be forced to continually reevaluate their retirement savings and goals.

This report focuses on the impact that different asset allocation strategies can have on retirement income. It will begin with a discussion on the necessity of retirement planning. This section describes issues such as increasing life expectancy, the uncertainty of social security, changes in pension benefits, and how these developments will affect an individual's retirement. The section after that will examine the cost of retirement. Many factors and assumptions must be considered in order to provide an appropriate figure. These include retirement age, replacement rates, inflation, expenses, etc. Common asset allocation strategies will also be explained and subsequently tested using stochastic projections. The results of these projections will then be analyzed and conclusions will be drawn on the effectiveness of various allocation strategies.

Chapter 2

Why Retirement Planning is Necessary

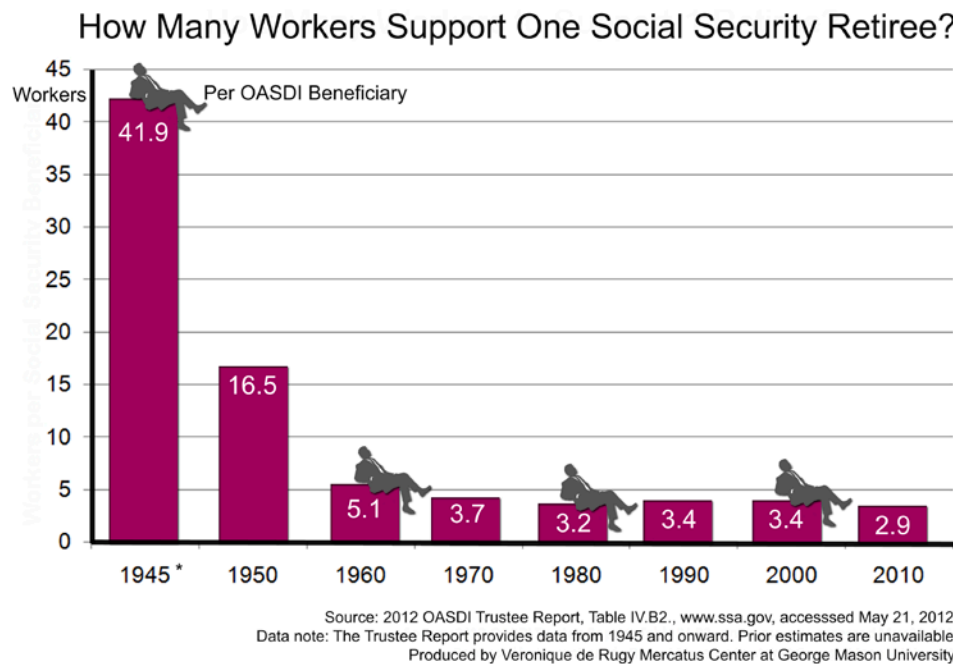
In the past, retirement was thought to be a short and mundane experience. Today however, that could not be further from the truth. Retirees in this day and age lead very active lives and are living longer than ever before. Retirement is now a significant portion of people's lives, sometimes lasting 30 years or more ("Introduction to Retirement Planning"). This increased activity and longevity present new issues in retirement planning, and require individuals to plan more extensively. Furthermore, changes in the sources of retirement income prompt those seeking a comfortable retirement to reconsider their goals. Traditionally, retirement rested upon three separate sources of income. These sources are pension benefits, social security, and personal savings. Over the past few decades, the natures of pension benefits and social security have changed, thereby increasing individual responsibility in retirement planning. With the recent financial crisis of 2008, and the generation of "baby boomers" approaching retirement age, retirement income and asset management have become a pressing subject of concern.

2.1 Uncertainty of Social Security

When discussing retirement planning in the United States, it is impossible not to talk about the state of social security. This is because social security plays a vital role in the retirement of millions of Americans. In recent times however, social security has faced new challenges and its future is now unclear. But before delving into the specific issues regarding this program, I will begin with some background context. Social security is defined by the Merriam-Webster dictionary as "a program in the U.S. that requires workers to make regular payments to a government fund which is used to make payments to people who are unable to work because they

are old, disabled, or retired” (Merriam-Webster). More specifically social security has two trust funds, the Old-Age and Survivors Insurance (OASI) and the Disability Insurance (DI). These two funds collect money through payroll taxes mandated by the Federal Insurance Contributions Act (FICA). In the early years of social security, the number of people receiving benefits was much smaller in comparison to the number of workers who were contributing money into the funds. According to the 2012 OASDI Trustee Report, in 1945 there were 46.4 million workers and only 1.1 million beneficiaries. In 2010 the number of workers was 156.7 million, but the number of beneficiaries increased to 53.4 million (ssa.gov). Figure 2-1 below depicts the number of workers per beneficiary from 1945 to 2010.

Figure 2-1. Ratio of workers per beneficiary (ssa.gov)

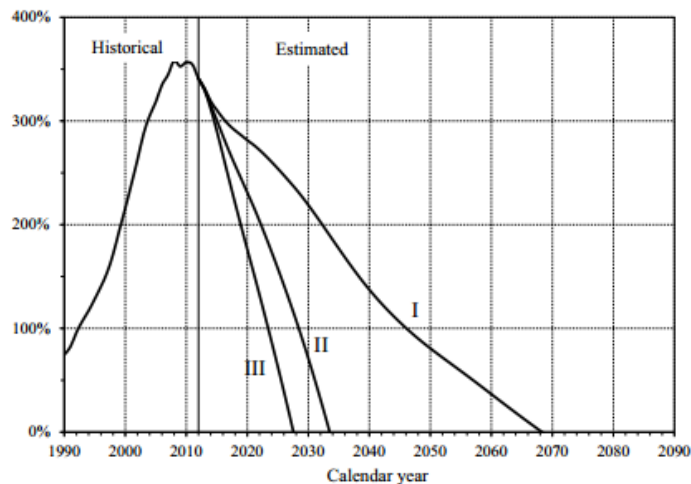


As a result of the decreasing ratio of workers to beneficiaries, the amount of money being taken out of the funds is increasing at a faster rate than the amount of money going in. By 2037, the Social Security Board of Trustees projects that the trust funds will be exhausted and only 76

percent of benefits will be able to be paid (Goss). One reason that the funds are projected to deplete so quickly is due to the generation of “baby boomers” approaching retirement age. This will simultaneously cause a decrease in the number of contributors and a hike in the number of beneficiaries, which will consequently decrease the worker to beneficiary ratio. Furthermore, people in general are living much longer than before. This increased longevity, to be discussed in a subsequent section, will lead to retirees collecting social security for a longer time. Unlike other federal programs, social security will only be able to pay beneficiaries if there is money in the trust fund. Because of that fact, if the money runs out, social security cannot borrow capital in order to maintain solvency (Goss). Figure 2-2 illustrates the combined assets of the OASI and DI funds over time.

Figure 2-2. Trust Fund Asset/Cost Ratio (2013 Trustees Report)

Figure II.D6.—Long-Range OASI and DI Combined Trust Fund Ratios Under Alternative Scenarios
[Asset reserves as a percentage of annual cost]



The three estimated fund assets, lines I, II, and III, represent optimistic, intermediate, and pessimistic cost assumptions respectively. The intermediate and pessimistic assumptions show fund assets as a percentage of program cost having peaked around 2010, and then being completely exhausted around years 2029 (under the pessimistic assumptions) or 2033 (under the intermediate assumptions). This is due to outgoing benefits being higher than tax revenue, which

ultimately leads to the depletion of the trust funds. Although the trust funds may be empty, FICA taxes are continuously being collected so that about three-quarters of benefits will still be able to be paid. In the past, the trust funds have been close to exhaustion, particularly between the years of 1973 to 1983 when the cash flow was negative (Goss). However, amendments made in 1977 and 1983 helped restore a positive cash flow and eventually built up a healthy reserve. Presently, we are again faced with the issue of a draining fund. The average benefit is about \$1000 per month per beneficiary. With a current worker to beneficiary ratio of around 3, each worker would be required to pay \$333 per month in order to sustain solvency. Looking into the future, the worker to beneficiary ratio is projected to drop to around 2 by year 2030 (Goss). In this case, workers would now need to contribute \$500 per month, a significant increase from the previous \$333. Few workers would back such a proposal. On the other hand, if social security fails to pay its beneficiaries, retirees may be left with no other choice but to rejoin the workforce. And the longer it takes to reach a consensus, the worse the situation becomes. Luckily, proposed ideas have been around and discussed for years.

As a matter of fact, there have been hundreds of papers written on ways to fix and reform

Table 2-1. Normal Retirement Age (ssa.gov)

Year of birth	Normal Retirement Age
1937 and prior	65
1938	65 and 2 months
1939	65 and 4 months
1940	65 and 6 months
1941	65 and 8 months
1942	65 and 10 months
1943-54	66
1955	66 and 2 months
1956	66 and 4 months
1957	66 and 6 months
1958	66 and 8 months
1959	66 and 10 months
1960 and later	67

social security. I will be discussing three of the potential solutions. The first method is to increase the retirement age. According to Penn State actuarial professor and board member of the American Academy of Actuaries Ron Gebhardtshauer, “Increasing the retirement age by just one month every two years starting in

the 2020s could fix 20% of the program's shortfall”. While this seems like an obvious answer to

the problem, it does come with a few difficulties. Firstly, the idea of increasing normal retirement age is already being implemented. Table 2-1 shows the increasing normal retirement age required to receive full social security benefits. The issue with this proposal is that even though normal retirement age has been increasing, it is still not keeping up with the benefit demands caused by a large older population with increased life expectancy. Increasing the retirement age at a faster pace would be difficult, considering the drastic changes it would cause for those nearing retirement. Another proposed idea is called “progressive indexing”. This plan would keep benefit levels the same for low income individuals, but would decrease the benefit amounts for people of middle or high income (Sahadi). Under this method, the social security benefits for the aforementioned two groups would be indexed to inflation and not wages. Since inflation typically grows at a slower rate than wages, the benefits to higher income people would be lower, and eventually, everyone would receive the same benefit, no matter how much they contributed. One of Social Security’s principles was that the more you contribute, the more you get. If that principle was lost, people might think of Social Security as a welfare program, which could lead to its demise politically. Lastly, the social security payroll tax could be increased. According to Social Security’s Chief Actuary Stephen Goss, if we wait until the funds are depleted to take action, “benefit reductions of around 25 percent or payroll tax increases of around one-third (a 4 percent increase in addition to the current 12.4 percent rate) will be required” to meet social security costs (Goss). In practicality, each one of these methods falls short if implemented alone, but if combined at varying degrees it could go further in potentially solving the issue. Despite whichever course of action is taken, people need to understand that social security is changing and people’s retirement plans and goals need to change with it.

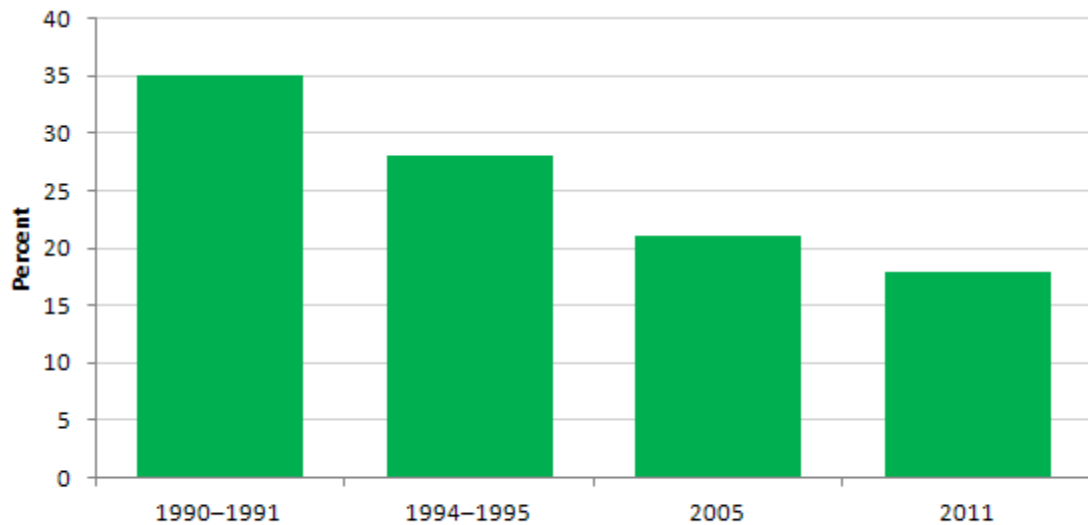
2.2 Defined Benefit vs. Defined Contribution Plans

In addition to social security solvency issues, workers are also facing another challenge, the changing nature of company benefit plans. Employers typically offer pension benefits in one of two methods, a defined benefit or a defined contribution plan. Defined benefit (DB) plans are employer-sponsored retirement plans where the benefits are based on salary and length of employment. These plans are not dependent on the return of invested funds. They are an employer's guarantee of retirement income to an employee provided in the form of a lifetime annuity. The second form of pension benefit is a defined contribution (DC) plan. These are plans in which the employee generally decides how much they wish to contribute and also how to allocate their contributions. Defined contribution plans are not a guaranteed source of retirement income; rather they are dependent on the return of invested funds. Oftentimes, DC plans offer lower value benefits when compared to DB plans. In the past few decades there has been a radical shift from defined benefit to defined contribution plans. Workforce.com reports that "as recently as 1998, defined benefit plans were the norm among the nation's largest employers, when 90 percent of Fortune 100 companies offered the plans to new salaried employees" (Geisel). Nowadays less than 30 percent of Fortune 100 companies offer defined benefit plans, as compared to 43 percent in 2009 (Geisel). Figure 2-3 shows the percentage of private industry employees participating in defined pension benefit plans.

The majority of financial risk now rests upon the shoulders of employees, many of whom have little or no knowledge of retirement planning and investments. These employees must now decide when to start saving, how much they should save, and where they should invest their money. This means that an individual's financial skills are extremely important to their financial well-being during retirement. Furthermore, it is the responsibility of the employee to manage key decisions of their retirement such as when they can retire, what they should do with their savings,

and how much to budget for spending. This paper aims to help people planning for retirement to look at all the different factors involved in the retirement process, and ultimately aid them in making these decisions.

Figure 2-3. Percentage of private industry employees with DB plans



Source: U.S. Bureau of Labor Statistics.

2.3 Increasing Life Expectancy

Life expectancy, also referred to as longevity, is the average number of years of life remaining at a given age. When dealing with retirement planning, life expectancy is of paramount importance. This is because the longer a person lives during retirement, the more income is needed to pay their expenses. Although longevity risk, the risk of outliving one's retirement income, has always been an issue, it is now more pertinent than ever. Due to the aforementioned changes in pension benefits and social security, a greater amount of financial responsibility is placed on the individual. Thus the risk of using up one's entire retirement fund is much higher. According to the 2011 Risks and Process of Retirement Survey Report by the Society of

Actuaries, in the last 50 years “life expectancy for newborn American males improved by an average of almost two years each decade, from 66.6 years in 1960 to 75.7 years by 2010. For females, the average increase was about 1.5 years per decade, from 73.1 years in 1960 to 80.8 years by 2010” (Helman). To put this into perspective, assume that a financial expert recommended a replacement rate of about 60% of pre-retirement income. According to the Social Security Administration, the average life expectancy for a male who has survived to age 65 in 1940 was 12.7 years and was 15.3 years for those who turned 65 in 1990 (SSA). If an individual who is a male had an income of \$100,000, then the extra 2.6 years of retirement equates to an additional \$156,000 of required cash inflow (assuming a normal retirement age of 65). Furthermore, the survey reports that “by age 65, U.S. males in average health have a 40 percent chance of living to age 85 and females more than a 50 percent chance. The survivor of a 65-year-old couple is more than 70 percent likely to reach 85. For healthier people, even a 25 percent reduction in mortality increases those chances to 50 percent for males, 62 percent for females, and 81 percent for the survivor” (Helman). Table 2-2 summarizes the probability of living to a certain age from 65 years old for people of average and above average health.

Table 2-2. Probability of Living from 65 to Various Ages (Source: SOA 2011 Survey Report)

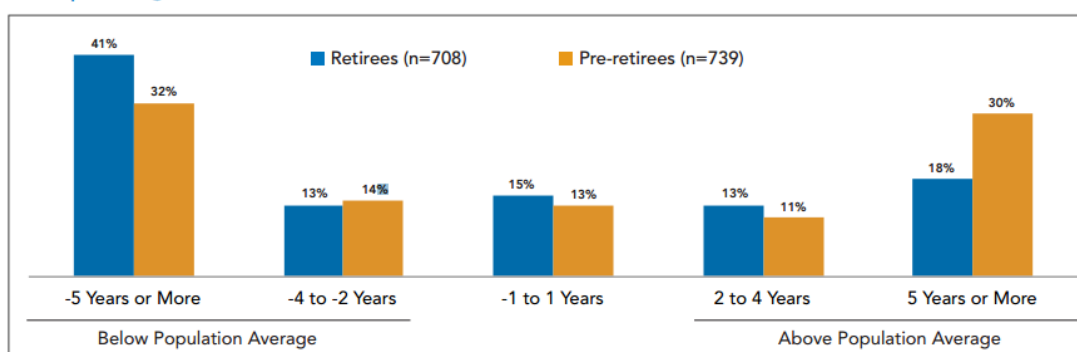
Probability of Living from 65 to Various Ages						
Age	Social Security Mortality			75% of Social Security Mortality		
	Male	Female	Survivor	Male	Female	Survivor
80	60%	71%	88%	68%	77%	93%
85	40%	53%	72%	50%	62%	81%
90	20%	31%	45%	30%	42%	60%
95	6%	12%	18%	13%	21%	31%
100	1%	3%	4%	3%	7%	10%

Much of the reason for increasing life expectancy can be attributed to advances in both medicine and health care. American retirees spend nearly 20 years in retirement now as opposed to only 13 years in 1940 (Shapiro). The rising longevity trend is quite apparent and could continue indefinitely into the future. While he’s not in the mainstream, Aubrey De Grey, Chairman and Founder of the Methuselah Foundation stated “[T]here is a 50% chance of radical life extension

therapies arriving in 25-30 years. If it does, lifespans could theoretically be extended almost indefinitely, and it is feasible that the first person to live for a thousand years might actually be alive today”. To exacerbate the situation further, more than half of the people surveyed in the Society of Actuaries Report underestimated the population life expectancy. 54 percent of retirees predicted that they would not live to the average population age, and only 31 percent believe they will live above the population average. Figure 2-4 shows the difference between an individual’s prediction of life expectancy and actual population life expectancy separated by current retirees and pre-retirees. This underestimation of life expectancy can be quite harmful to those seeking a stable retirement, especially individuals who plan on managing their own withdrawals. The reasoning is that if an individual were to expect say ‘X’ number of years of retirement, then they would only budget their assets for that amount of time. However, since the population data suggests a population life expectancy of ‘Y’ years which is greater than ‘X’, then the individual would run out of retirement income before death (except for social security).

Figure 2-4. Difference between estimated life expectancy and actual population life expectancy (SOA 2011 Risks and Process of Retirement Survey Report)

Difference between respondent estimate of personal life expectancy and actual population life expectancy (among those providing an estimate).



One way people can protect against using up all of their retirement income is by buying an annuity. Although annuities are not an absolute guarantee, they do lessen the financial risk of running out of money due to longevity. Whether people manage their own withdrawals or buy

annuities, they need to understand that life expectancy is increasing and new issues are arising because of it.

Chapter 3

The Cost of Retirement

A successful retirement centers around a financially stable and self-sufficient retirement fund. While it is impossible to determine an exact amount of money needed in retirement for each individual, it is not impossible to calculate a reasonable estimate. The three most common methods for estimation involve replacement ratios, minimum needs measures, and personalized cash flow forecast. While these methods provide a basis for calculating retirement fund adequacy, costs can be unpredictable and change over time. Therefore it is imperative that assumptions are made conservatively and expected changes are incorporated into the calculations. Furthermore, buying an annuity versus managing one's own funds will affect how much retirement income is allotted every month and how long the income will last. The subsequent sections discuss various methods of retirement cost estimation and key assumptions that must be made in order to arrive at that cost. Additionally, a simulated calculation will be used to illustrate potential cost scenarios.

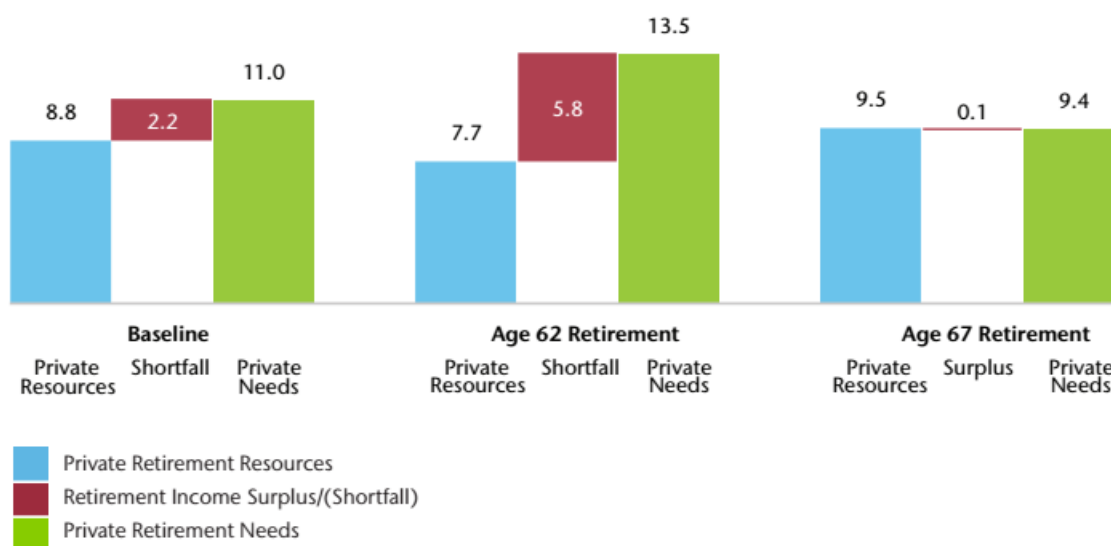
3.1 Key Assumptions

When calculating an estimate for retirement income, there are numerous assumptions that must be made. The first and foremost is the age at which an individual would like to retire. The age is important in calculations because it affects how much social security an individual receives, how much time investments have to grow, and how much expected time the retirement fund has to last. For example, according to a study done by Aon Hewitt, "deferring retirement to age 67 allows almost 50% of employees to achieve adequate retirement income compared to 29% of employees when retiring at 65" (Aon Hewitt). Figure 3-1 depicts the private retirement

resources versus needs for people who retire at different ages. This graph shows that with social security taken into consideration, an individual planning to retire at age 65 will need 11 times their final pay in order to afford retirement. Individuals who retire early at the age of 62 will need 13.5 times their final pay, and those who retire late at age 67 need only 9.4 times their final pay. Notice how in the first two cases there is a shortfall in assets at the time of retirement. However, the third graph of someone retiring at age 67 shows a slight surplus in private resources. This reflects more contributions being made, a longer time for investments to grow, and also a decreased length of time that the retirement funds must last. Undoubtedly, it is advantageous for an individual to retire at a later age, but oftentimes people are not willing to wait.

Figure 3-1. Private Retirement Resources versus Needs for Age 65 (Baseline), Age 62, and Age 67 Retirement

(Source: Aon Hewitt)



Another assumption that is critical in determining the adequacy of retirement assets is mortality. Since the exact age at which an individual dies is impossible to predict, a mortality table must be used. For example, in determining the cost of an annuity, mortality rates are used because the number of years a person lives directly affects the number of payments the annuity

will ultimately pay. Furthermore, the gender of the individual will affect the estimated cost of retirement as well since different genders have different mortality rates. On average females live longer than males. The calculations in this study will be based on the US Annuity 2000 mortality table. While these tables are mainly used by insurance companies to calculate annuity prices, it could also help people who decide to manage and systematically withdraw their own funds during retirement by providing an estimate of their longevity.

Lastly, an assumption must also be made on both interest and inflation rates. Since annuities are bought with a lump sum, insurance companies must forecast interest rates into the future and then bring all cash flows to the present time to calculate the lump sum value. This is called the present value of an annuity. Furthermore, as time passes the purchasing power of money decreases due to inflation. This means that money required for buying a nice meal in say ten years will cost more than it does today. In order to account for this, the real interest rate, equal to the interest rate minus the inflation rate, will be used. By doing this, the annuity will increase with inflation. The calculations in this study utilize Moody's AAA bond interest rates and historical inflation rates.

3.2 Replacement Ratio

One of the most common methods of estimating the cost of retirement is the replacement ratio. The general idea for this method is that expected retirement costs can be based on pre-retirement income. By using pre-retirement levels of income, an individual can expect to maintain the same standard of living during retirement as during their working years. Typical measures used for the pre-retirement level of income are final average pay, an average of income over the last few years of employment, or the final pay. Moreover, the ratio can be calculated based on

gross income or after-tax income. The estimations done in this paper are calculated using final gross income.

When using the replacement ratio to calculate annual retirement costs, it is not appropriate to use 100 percent of the final pay as the benchmark. There are numerous financial changes that occur once an individual begins retirement and therefore adjustments must be made in order to provide a more accurate estimation. The 2013 Society of Actuaries Measures of Retirement Benefit Adequacy study reports the major adjustments which must be made are “removal of work related expenses, Social Security taxes, adjustments in other taxes, removal of assumed retirement savings, and adjustments for the difference in employee costs for health benefits” (Bajtelsmit). More specifically, income taxes will be reduced since taxable income during retirement is usually lower. Social security taxes will end completely at retirement, and contributions to a retirement fund will no longer be necessary. Benefits received from social security are partially or entirely tax-free, which explains the aforementioned reduction in taxable income. While work-related expenses, social security taxes, and retirement contributions are straightforward and easy to account for, employee costs for health benefits vary greatly company to company and plan to plan. Therefore for the purposes of this study, in order to provide simpler calculations and scenarios, health benefits will be omitted. Table 3-1 shows typical replacement ratios from Aon for an individual retiring at age 65.

Table 3-1. Replacement Ratios (Source: Aon Consulting Replacement Ratio Study)

Aon Baseline Replacement Ratios (married ages 65/62, one working)			
Pre-Retirement Income	Replacement Ratios (2008 study)		
	From Social Security	From Private and Employer Sources	Total Ratio
\$ 20,000	69%	25%	94%
\$ 30,000	59%	31%	90%
\$ 40,000	54%	31%	85%
\$ 50,000	51%	30%	81%
\$ 60,000	46%	32%	78%
\$ 70,000	42%	35%	77%
\$ 80,000	39%	38%	77%
\$ 90,000	36%	42%	78%
\$ 150,000	23%	61%	84%
\$ 200,000	17%	69%	86%
\$ 250,000	14%	74%	88%

The percentage of social security is larger for individuals with lower pre-retirement levels of income because social security provides a subsidy for lower income people.

While replacement ratios can be a good method of estimating costs, there are a few shortfalls. First of all, this method assumes that most if not all of pre-retirement income was being utilized. However, this is not true for all people and spending habits vary greatly from person to person. Replacement ratios may be more appropriate for people of low to moderate income, since people with higher income tend to have more disposable income and therefore a greater variance in spending. Moreover, replacement ratios do not take into account other expenses aside from the previously mentioned ones, and does not work well with changes over time. With these limitations in mind, the calculations for this study will utilize the replacement ratio method.

3.3 Minimum Baseline

An alternative to replacement ratios is the minimum baseline method. Whereas replacement ratios try to maintain preretirement standards of living, the minimum baseline method does what the name implies; it provides an estimate for the minimum amount of money required for retirement. Although this method is not typically used, it can help individuals determine if they can significantly reduce spending, especially useful if retirement age is approaching and funds are inadequate (Bajtelsmit). Expenses taken into account include housing, food, transportation, healthcare, and miscellaneous costs. Table 3-2 shows monthly expenses for elders of different household types. The household types are divided by marriage status and whether the individual is the owner of a house without mortgage or a renter. Housing is typically the most expensive item on the list and is an area where retirees can cut costs. As the table shows, an estimate of minimum retirement needs for person of single status and owner of a house with no more mortgages is around \$16,415. This estimate is significantly lower than an amount

suggested by the replacement ratio method. A large part of that reduction is due to the no mortgage assumption. The replacement ratio method should be reduced by the mortgage amount, if it is no longer being paid. One thing to keep in mind however is that the cost presented in the table can vary from area to area, especially housing costs. It is therefore most beneficial for an individual to use a local index to account for that variation. Although few people actually use this method for estimating retirement costs, it can serve as a warning of benefit inadequacy for those whose funds do not measure up to this minimum baseline. Furthermore, when paired with the replacement ratio, it can provide a range between minimum and current living standards.

**Table 3-2. The Elder Economic Security Standard Index
US Average Monthly Expenses for Selected Household Types, 2010**
(Source: National Economic Security Initiative January 2012 Fact Sheet, citing Conahan, et al. (2006). Values inflated to 2010 using the Consumer Price Index)

Monthly Expenses	Elder Person	Elder Person	Elder Couple	Elder Couple
	Owner w/o Mortgage	Renter	Owner w/o Mortgage	Renter
Housing	\$372	\$698	\$372	\$698
Food	231	231	424	424
Transportation (Private Auto)	283	283	346	346
Health care	254	254	508	508
Miscellaneous	228	228	330	330
Elder Index Per Month	\$1,368	\$1,694	\$1,979	\$2,305
Elder Index Per Year	\$16,415	\$20,328	\$23,751	\$27,773

3.4 Cash Flow Forecast

Perhaps the best method for estimating cost of retirement is a personalized cash flow forecast. A forecast of this magnitude would require detailed information such as purchasing habits, housing costs, investments, travel, health costs and more. Moreover, assumptions on yearly inflation and interest rates must also be made, and need to be updated frequently. Few individuals would be able to make such a forecast without the help of a financial advisor. Since people do not know exactly how much they expect to spend during retirement, this method is

more appropriate as the individual is nearing retirement age. Although this method provides the most accurate estimate of retirement costs, it is very complicated and impractical for many individuals.

3.5 Sample Cost Calculations

Consider a hypothetical case for calculating the retirement cost of a student named Paul who is currently 19 years old. Three different scenarios will be presented; one where Paul retires early, one where he retires at normal retirement age, and one where he retires after normal retirement age. The following are factors and assumptions relevant to retirement calculations.

- Paul will be graduating at age 21 and be receiving an annual gross income of \$65,000.
- Merit pay increase percentages from promotions will begin at 3 percent and decrease linearly to 0 percent by age 50.
- Inflation rates and wage growth percentages will be based on historical rates, starting in year 1956.
- Paul has no other sources of income or savings, and no company pension plan.
- A replacement ratio of 70 percent will be used on a pretax gross final pay.
- Social Security will be expected to cover a percentage of his preretirement income, depending on his retirement age
- A Target Date Fund will be used which means Paul's investments will become more conservative as he nears retirement.

Scenario 1: In this first scenario, Paul would like to retire early at age 62. In order to calculate the replacement ratio, we must first calculate Paul's final gross pay. He begins in year 2015 with a

salary of \$65,000. With wage growth and merit/promotion increases, Paul is expected to be earning \$838,129 by age 62. About 70 percent of this amount will be needed in order to maintain his standard of living, and 16 percent will be covered by social security income. This means that Paul has to replace about 54 percent of his final pay, or \$452,590, every year during retirement increasing by inflation. Based on gender, real rate of interest, and desired retirement age, the present value of a \$1 life annuity costs \$17.37. We then multiply this by his required annual income of \$452,590 to get **\$7,859,555**. This is the amount of money Paul would need if he retired at age 62. In order for Paul to accumulate this amount by the time he retires, he would need to contribute about 11 percent of his income every year starting in 2015.

Scenario 2: In this second scenario, Paul will be retiring at a normal retirement age of 65. Similar to the previous scenario, we must first calculate Paul's final pay. By taking the extra 3 years of work into consideration, Paul's final gross pay comes to \$976,430. Again, 70 percent of his income will need to be replaced. Since he is now retiring at age 65, Social Security will replace about 20 percent of his salary. Therefore, 50 percent of his final pay will need to be replaced so Paul will need $\$976,430 \times 50\% = \$488,215$. Based on a later retirement age, and a higher real interest rate, the present value of a \$1 life annuity is now only \$14.81. Therefore he will need **\$7,288,093** by age 65. Due to the decreased price of the annuity and more time for his investments to grow, Paul will only need to contribute about 8 percent of his income every year.

Scenario 3: In this last scenario, Paul decides that he would like to work two more years and retire at age 67. At this age, Social Security will pay 23 percent of his income so he will need to replace $70-23 = 47$ percent of his income. His final pay in this situation is \$1,086,548 and thus he needs to replace \$510,678 annually. Again, the present value of a \$1 life annuity has dropped due to his later age of retirement and it is now \$13.77. The real interest rate in this particular year of

retirement has also increased, contributing to the decreased present value of the annuity.¹ The estimated amount needed at retirement for this scenario is **\$7,031,372**. Paul will now need to contribute about 6 percent annually in order to achieve this amount.

In conclusion, there are a few results that can be drawn from these outcomes. First of all, the later a person retires, the less a lifetime annuity will cost. This is key information for those seeking to buy an annuity for retirement, and benefits those who decide to retire at a later age. The cost of a \$1 lifetime annuity decreased from \$17.37 at age 62 to only \$13.77 at age 67. In addition, retiring at a later age will allow investments more time to grow. These reasons result in smaller required contribution percentages the longer an individual waits to retire. In Paul's case, his contribution rates decreased from 11 to 8 to 6 percent when retiring at ages 62, 65, and 67 respectively. We must keep in mind that since the majority of Paul's investments are in bonds around the time of his retirement, he will be less affected by the volatility of stocks. If he had a majority of his investments still in stocks right before retirement, and stocks crash by say 50 percent, then he would have needed to contribute twice the amount of money. Furthermore these calculations show a consequence of using the replacement ratio method. The difference in replacement amount increased from \$452,590 annually at age 62 to \$510,678 only 5 years later at age 67. This significant increase is primarily due to inflation. However, since the replacement ratio is based on a percentage of final pay, it increases proportionally to final pay. One thing is for certain in all three scenarios; 7 million dollars is a large required amount of money for retirement (partially due to inflation) so planning and choosing the right strategy, especially at a young age, is essential.

¹ In this particular economic scenario the real interest rate increased, leading to the decreased present value of the annuity. If another set of years was used however, the real interest rate could have decreased, causing an increase in the present value of the annuity.

Chapter 4

Asset Allocation

Now that we have calculated an estimate for the cost of retirement, we must determine how to reach that amount. This leads us to the most important decision we have to make when building a retirement fund, how to invest our assets. This process, known as asset allocation, is defined by investopedia.com as “an investment strategy that aims to balance risk and reward by apportioning a portfolio's assets according to an individual's goals, risk tolerance and investment horizon” (Investopedia). How an individual apportions their contributions to different asset categories will determine how fast their fund grows and how much will be available upon retirement. According to Roger Ibbotson’s study, *The True Impact of Asset Allocation on Returns*, “for the long-term individual investor who maintains a consistent asset allocation and leans toward index funds, asset allocation determines about 100 percent of performance” (Ibbotson). Unfortunately there is no consensus on which asset allocation strategy is most effective. Therefore it is imperative that each individual explores available asset allocation strategies and chooses one that best fits their own goals, risk tolerance, and needs. Since each individual has unique retirement objectives, it is not practical to go into detail about every possible investment strategy and scenario. With that in mind, this study will discuss some of the basics of asset allocation and present stochastic projections of a few scenarios in order to illustrate their significance in retirement fund adequacy.

4.1 Risk Tolerance and Time Horizon

Two of the biggest factors in deciding how to allocate one's investments are risk tolerance and time horizon. Risk tolerance refers to how much fluctuation or volatility on returns an individual is willing to bear. Typically investments with a potential for higher yield will be riskier. When evaluating risk tolerance, an individual must consider their retirement goals, how they react to negative outcomes, and whether or not they have enough money to take the risk. For example, people who cannot handle seeing their investments drop in value should not invest in risky assets. Investments in stock have potential for high returns but it comes with a large variance as compared to more conservative investments like bonds. If you are willing to take a risk for a high return, you must also be willing to potentially lose a lot of money. This is why many financial advisors suggest a target-date fund. These funds invest more conservatively as the individual approaches a target date, usually the date of retirement. This way, the individual is much less likely to lose a large portion of their savings right before their target date, leaving them unable to retire. For individuals approaching retirement age with a fund that is not on track to reach their retirement goals, investing more heavily in stocks is not a solution. If there is only a few years left until retirement, owning more stocks will not get that much more money, and will open the individual to huge risks due to stock volatility. People in this situation should either work longer or have saved more in the past. Risk tolerance is also closely tied to time horizon. Time horizon is the amount of time left before retirement, and should affect an individual's decision in asset allocation. If a person has a long time horizon such as thirty years or more, they will not only have more time for their investments to grow but also can bear more risk. This is because the individual will have time to recover from a catastrophic market crash, such as the one in 2008.

4.2 Investment Choices

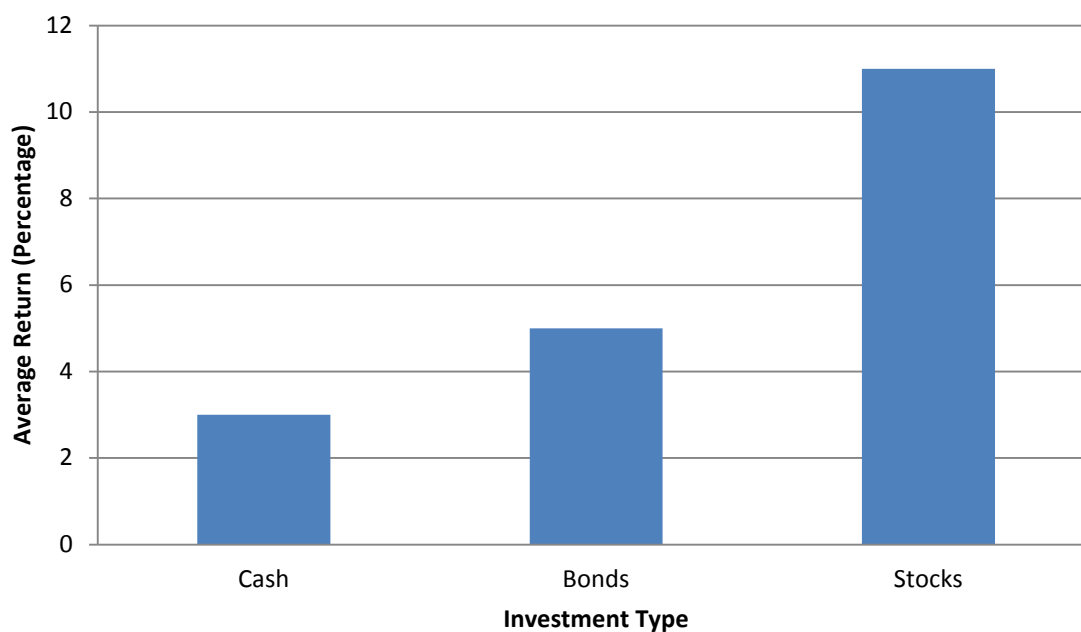
The main objective of asset allocation is to achieve financial retirement goals. In order to do this, one must apportion their contributions in different investments in a way that both maximizes their return and also minimizes risk. The three categories for investments are cash, fixed income, and equities. These three categories can further be divided into subcategories. Below is a list of the common subcategory investments used in retirement planning.

- Money Market Funds – Extremely liquid debt securities which typically mature in less than one year.
- Government Bonds – Fixed income securities offered by the U.S. government also referred to as Treasuries. These are classified by maturity length (short-term, medium-term, and long-term). Short-term bonds typically mature in less than 3 years, medium-term bonds between 3 to 10 years, and long-term bonds mature in 10+ years. Shorter term bonds are usually less risky and also have lower yield. Government Bonds overall carry less risk than stocks.
- Corporate Bonds – Bonds issued by companies. These bonds typically have higher yields than government bonds since there is higher risk of a company defaulting than a government.
- Large Cap Stock – Shares offered by large companies with more than \$10 billion in market capitalization (total market value of all of the company's shares). Typically has lower volatility than mid or small cap stocks. These stocks are sometimes called “blue-chip stocks”.
- Mid Cap Stock – Shares offered by medium sized companies with market capitalization of between \$2 billion to \$10 billion.

- Small Cap Stock – Shares offered by smaller companies with market capitalization of less than \$2 billion. They have higher average returns, but also higher risk.
- International Securities – A security offered by a country other than the U.S. This type of security allows for diversification outside of the U.S. but can be riskier.
- Emerging Markets – Securities offered by developing countries. Has potential for higher yield but also more volatile.
- Real-Estate Investment Trusts (REITs) – Similar to stocks, with property ownership as the underlying asset as opposed to company ownership.

Note that “from 1925 through today, cash investments generated average returns of 3 percent a year, bonds averaged a little over 5 percent and stocks averaged about 11 percent” (“401k Asset Allocation”).

Figure 4-1. Averaged Returns from 1925 to Today of Different Investment Types (“401k Asset Allocation)



This is the general trend in investments where the riskier the investment, the higher the average yield. Figure 4-2 shows a graph of risk versus return on some investment choices.

Figure 4-2. Comparison of Risk and Potential Return on Investments (Source: Investopedia)



4.3 Diversification

No matter which investment strategy an individual ultimately chooses, there is one thing they must do; diversify, diversify, diversify! The age old saying, “don’t put all of your eggs in one basket”, sums up why diversification is critical in investing. This is because no single type of non-US Government investment is immune to failure, but the chances of a significant loss occurring over a wide distribution of investments is very unlikely. It is therefore critical that investments are spread over bonds, stocks, and other securities. If for example, an individual only invested in stocks, then another stock market crash like the one in 2008 could cause losses of up to 70 percent! Not only should the investments vary by type but they should also vary by risk. By

doing so, large gains from one investment can help to offset losses elsewhere. Furthermore investors should also try to diversify across industries, as entire industries have been known to collapse.

Chapter 5

Stochastic Projections

Previous chapters have examined why planning for retirement is necessary, how to estimate the cost of retirement, and guidance on asset allocation. The focus of this chapter is to combine everything that has been discussed thus far and simulate projections based on different scenarios. As previously mentioned, it is beyond the scope of this paper to go into projections which involve complex investments and detailed cost analysis. Rather, the purpose of these projections is to provide insight into the effects of asset allocations based on historical returns and their impact on retirement planning.

5.1 Allocation Scenarios

There is an endless amount of ways to allocate one's assets. This paper will examine a few of the more common asset allocation models such as conservative, moderate, and aggressive investing, as well as the glide path or target date fund model. Furthermore, it will analyze the extremes in asset allocation, i.e. 100 percent bond and 100 percent stock allocation. The time an individual begins to invest versus total assets at retirement will also be studied in order to illustrate the volatility of investments. Below are different asset allocations which will be used as a basis for the projections.

Conservative Portfolio: A conservative approach to asset allocation means that the majority of funds are invested in low-risk securities. This type of strategy is often used when an individual is approaching retirement age in order to reduce risk of a significant loss right before retirement

begins. Conservative portfolios are sometimes referred to as “capital preservation portfolios” since its main goal is to preserve the initial investments. The projection using this method will maintain 75 percent bonds, and 25 percent stocks throughout the entire investment duration.

Moderate Portfolio: A moderate approach to asset allocation is also referred to as the balanced method. The asset composition for this method is typically split equally between fixed income securities and equities. This combination provides a potential for higher returns than the conservative approach but also carries more risk. The projection of a moderate approach will maintain 50 percent bonds and 50 percent stocks throughout the entire investment duration by reallocating assets at the end of each year. This this projection will also be done without reallocation to examine its relationship with a 100% stock and 100% bond portfolio.

Aggressive Portfolio: An aggressive approach to asset allocation means that the majority of funds will be invested in high-risk securities. People tend to select this approach when they have a long time horizon since returns will fluctuate widely. The projection of an aggressive portfolio will maintain 75 percent stocks and 25 percent bonds throughout the entire investment duration.

100 Percent Bonds/100 Percent Stocks: In order to illustrate the earning potential and variance between high-risk and low-risk securities, two extreme scenarios will be projected: a 100 percent allocation of funds in bonds, and a 100 percent allocation of funds in stocks.

Target Date Fund (Glide Path): A target date fund is a method of asset allocation which becomes more conservative as one approaches retirement age in order to reduce risk. It is also known as a glide path, and typically has (65-age) percent invested in stocks and the remainder invested in bonds. This method is dynamic, as percentage of investments in stock decreases yearly.

Rising Equity Glide Path: Some new studies indicate that the opposite of a target date fund approach might yield better returns. In this case, we start with a conservative portfolio and then increase the percentage allocated in stocks as one approaches retirement age. The projections using this method will begin with 0 percent in stocks and increase linearly until it is 100 percent stocks by the age of retirement.

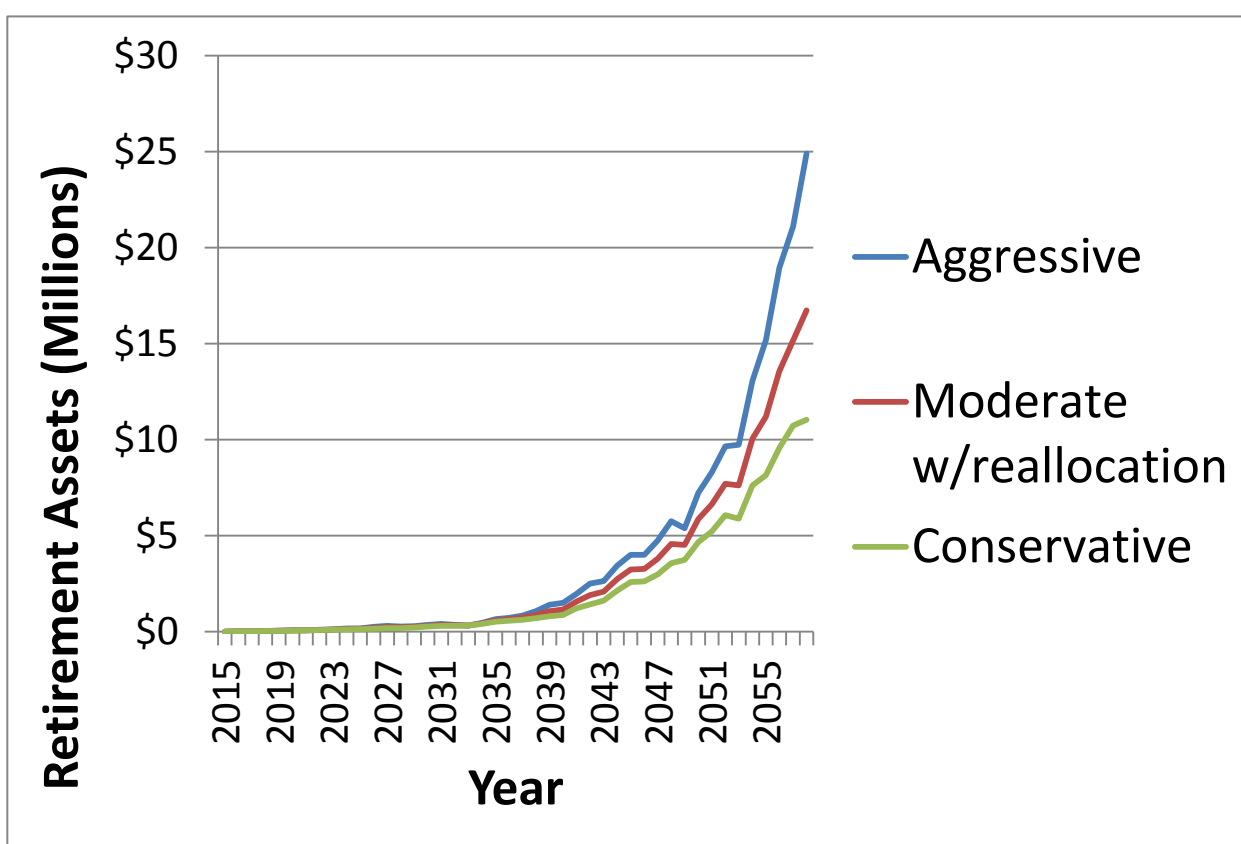
5.2 Projections

Let us return to the example of 19 year old Paul. We will use the same assumptions as we did before, and will be projecting retirement assets using the retirement at age 65 scenario. Investment options in these projections will be limited to large and small cap stocks, long term and medium term government bonds, and long term corporate bonds. The returns on these securities are based on historical rates beginning in year 1956, and a contribution percentage of 10 percent will be used in calculations. In other words, 10 percent of Paul's annual income will go into his retirement fund. Unless otherwise specified, calculations requiring bond returns will utilize the average return of long term corporate, long term government, and medium term government bonds, and stock returns will utilize the average of large cap and small cap stocks.

Conservative, Moderate, and Aggressive Portfolios: Figure 5-1 below shows the projected assets in the retirement fund from year 2015 to the end of year 2058 when Paul is 65 years old and expects to retire. Each of these approaches assumes reallocation of assets at the end of each year to maintain their respective asset distributions. The conservative portfolio ended with the least amount of \$11,034,626 in assets while the Aggressive portfolio had more than twice that amount of \$24,901,716. Not only does the aggressive approach end with a higher total asset amount, but

it also grows at a faster pace as indicated by its higher slope. In this situation, it can be beneficial for Paul to take the aggressive approach in asset allocation. However, we must keep in mind that Paul had a very long time horizon, which allowed him to take on more risk. However, he has a large risk if the stock market crashes right before he wants to retire. Investing aggressively will generally produce more in the long run than a conservative approach.

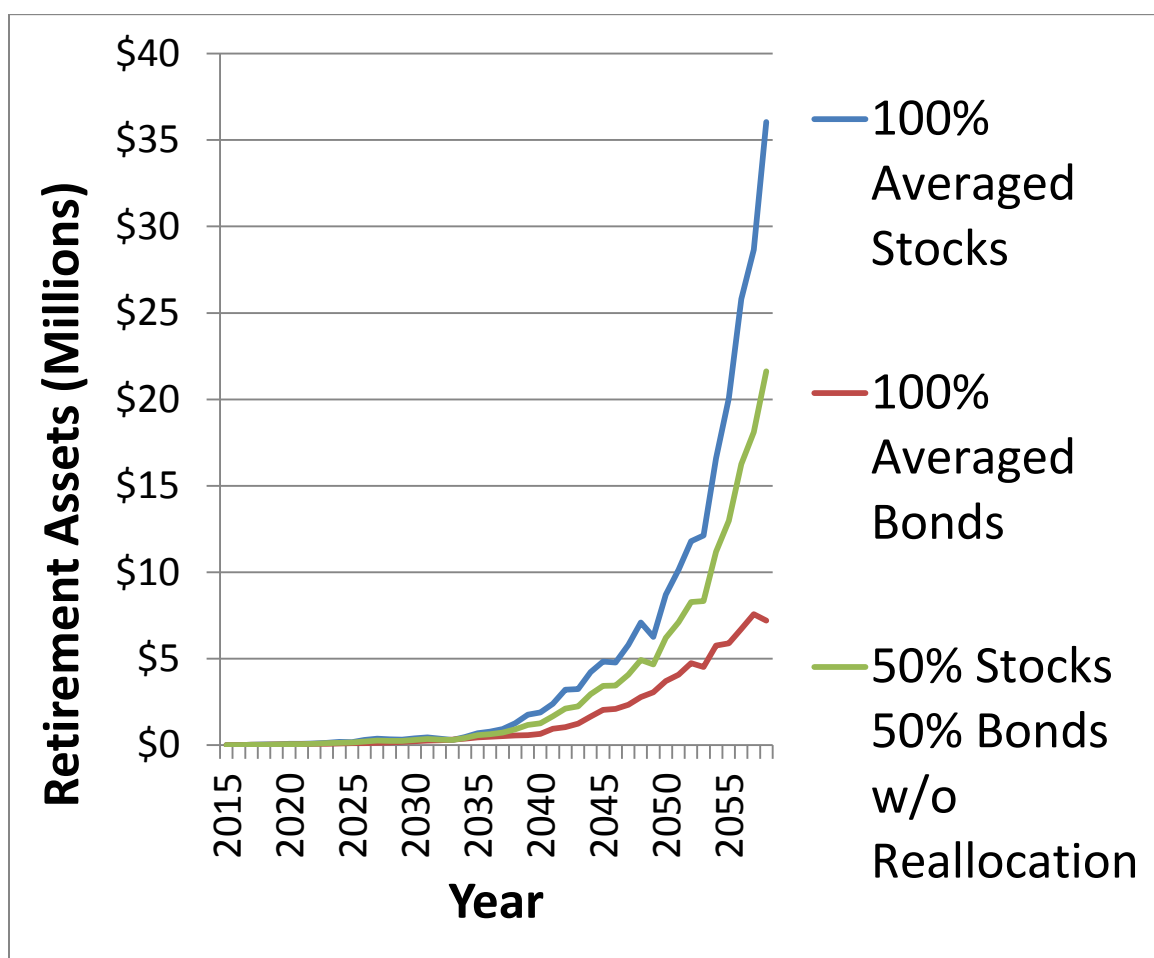
Figure 5-1. Total Assets At Each Year Using Conservative, Moderate, and Aggressive Approaches



100% Stock, 100% Bond, and Equal Distribution Portfolios: In order to illustrate the extreme approaches to asset allocation, the following projection shows the amount in the retirement fund at the end of each year from 2015 to 2058 by three models: a 100 percent allocation of assets in stocks, a 100 percent asset allocation in bonds, and a 50/50 split between stocks and bonds. Note

that the return percentages used for stocks is the averaged return of large and small cap stocks, and the return for bonds is the averaged returns of long term, middle term government and long term corporate bonds.

Figure 5-2. Total Assets at EoY Using 100% Stocks, 100% Bonds, and 50% Stocks 50% Bonds Models

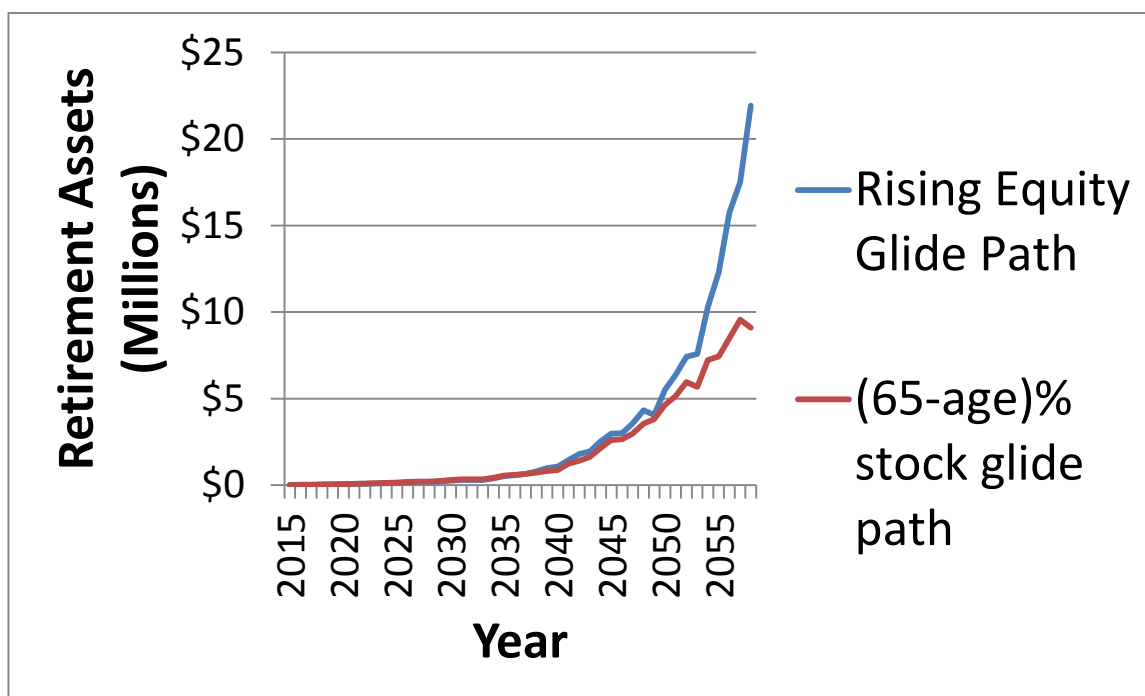


Once again, the more aggressive approach of allocating entirely in stocks produced the best results. With 100 percent allocation in stocks, the total amount of assets at retirement is \$36,037,133, an amount that is 45 percent higher than the aggressive approach. It is interesting to note that the 50/50 approach yielded a total final asset amount which is exactly between the 100 percent stock and 100 percent bond portfolios. However, this is only the case when the returns at

the end of each year are not reallocated to maintain the 50/50 ratio. Furthermore the 100 percent allocation in bonds, an approach that takes on even less risk than the conservative portfolio from above, yielded a final amount of \$7,214,366. This is the lowest result out of all models tested thus far.

Glide Path Models: One of the most common methods for retirement asset allocation is the Target Date Fund or the Glide Path. This approach begins with a somewhat aggressive investment strategy and then becomes more conservative as one approaches retirement age. Two different types of glide paths will be analyzed in this study. The first one is the typical (65-age) percent allocation in stock glide path. In this projection, the first year will use a 44 percent stock allocation (since Paul is age 21 when he begins contributing) and will decrease by 1 percent every year thereafter. The second approach is a fairly new idea and it is the opposite of a Target Date Fund. This method recommends a rising equity glide path. We will therefore start with a 0 percent stock allocation increasing to 100 percent by age 65.

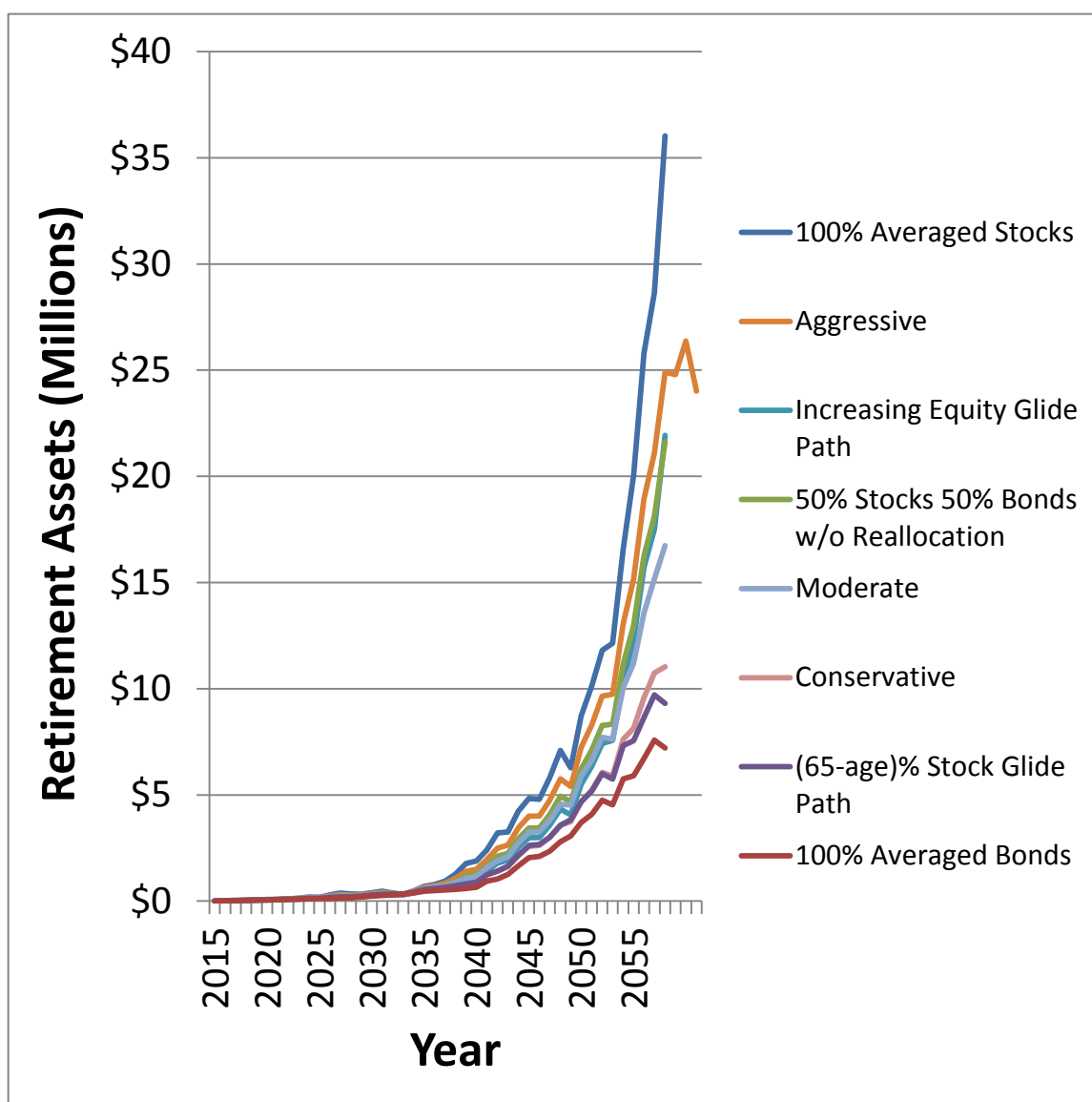
Figure 5-3. Target Date Fund and Rising Equity Glide Path Models



The rising equity glide path ends up with a larger fund at retirement because the larger balances of the later years are invested in equities which happened to have good returns in the years close to retirement. It produced an end total of \$21,935,835 whereas the normal glide path returned \$9,097,097. However, it has way more risk right before retirement.

Comparison of all Asset Allocation Strategies: Figure 5-4 depicts all aforementioned asset allocation methods together. This way, it is easier to see which strategies outperformed others.

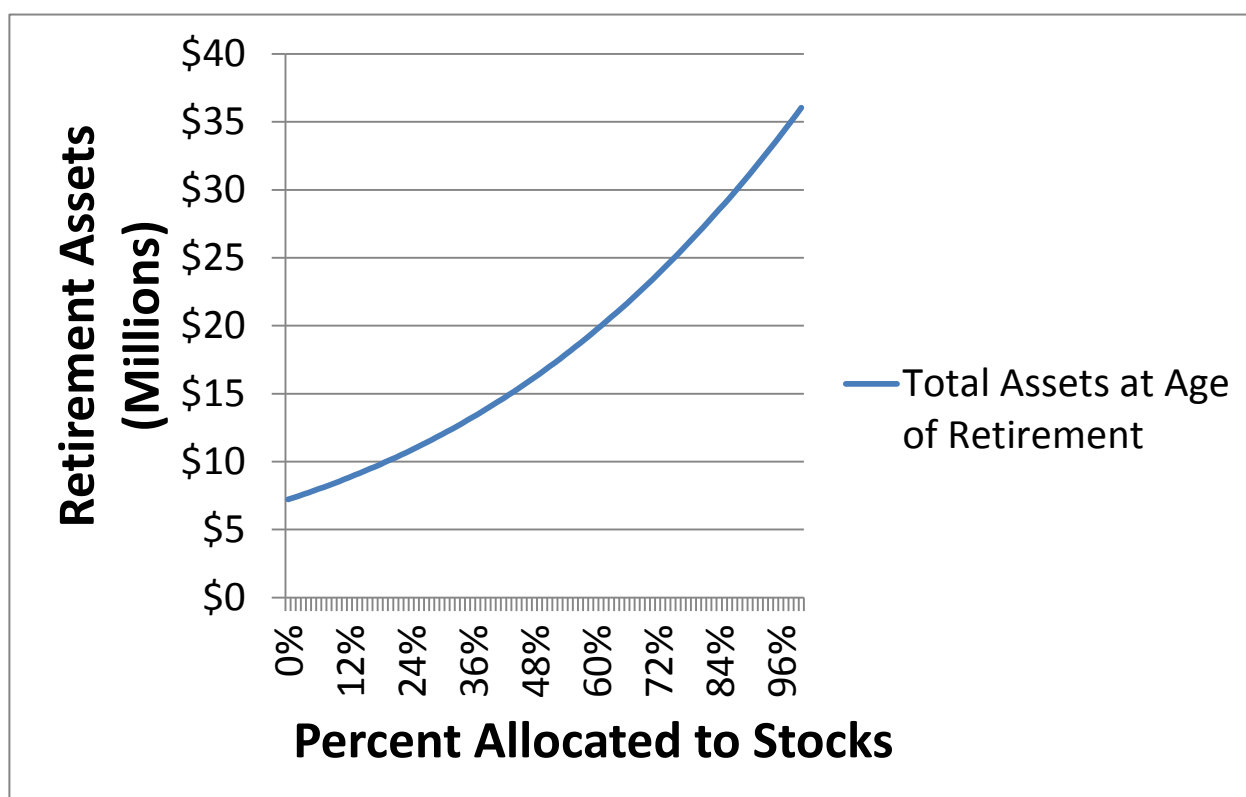
Figure 5-4. Asset Allocation Strategies



The asset allocation strategy which produced the highest returns is the 100 percent allocation in stocks while the strategy with the lowest return is the 100 percent allocation in bonds. The rest of the returns seem to be highly dependent on how heavily the portfolio is allocated in stocks; the higher the percentage of stocks, the better the return. However, we also need to look at the volatility of the market in the years preceding retirement. If lots of risky stocks are held then, the pre-retiree could lose a lot of money and not be able to retire. This is discussed in a later section.

Modeling with Range of Stock Allocation Percentages: By isolating the stock allocation percentage, we can model to see how the percentage of stock in a portfolio affects the returns.

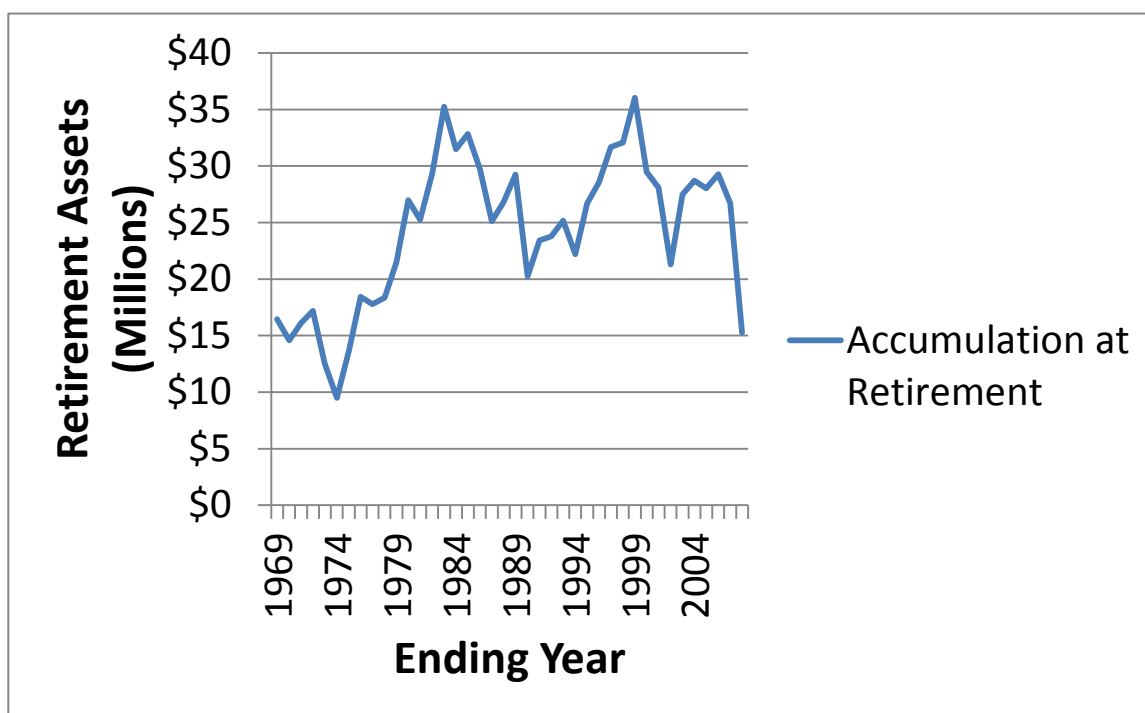
Figure 5-5. Retirement Assets based on different percentages of stock allocation



It is apparent that there is a direct and positive relationship between percentage of portfolio allocated to stocks and the total amount of assets at retirement. However this may only be the case for people with a long time horizon such as in our example with Paul.

Accumulation of Funds with Different Historical Starting Years: So far all of the projections used historical stock and bond returns starting from year 1956. This is a very risky assumption to make since returns starting this year and ending at retirement age are not necessarily representative of expected returns for all years. The following figure 5-6 projects the assets at retirement age for a 100 percent stock portfolio using historical stock returns based on year 1926 to year 1965.

Figure 5-6. Accumulation at Retirement Based on Different Starting Years for Historical Returns



This graph shows that the year which historical returns are based on has a significant impact on total assets at retirement. In fact, the graph fluctuates from a low of \$9,489,321 to a high of \$36,037,133! This is due to the inherent risk in stocks and is one of the reasons why

financial advisors prefer a more conservative portfolio as an individual nears retirement. In fact, stocks can be so volatile that in 2008, the average return on large and small cap stocks was -36.86 percent. Note also that the chart shows major losses in assets in ending years 1974, 1990, 2001, and 2007. This is because these were the years in which the stock market crashed. In our scenario, the individual went from a retirement fund of \$26,741,084 to just \$15,254,323 in the span of one year (using historical data from 2007 to 2008). As a result, many people lost a significant portion of their investments during the financial crisis of 2008. Analysis of the variance of the different investments options shows that stocks have the highest variance, particularly small cap stocks, and bonds have lower variance with medium term government bonds having the lowest variance.

Table 5-1. Variance of Investments

<u>Investment</u>	<u>Variance</u>
Large Cap Stocks	0.040739
Small Cap Stocks	0.104554
Long Term Government Bonds	0.009471
Medium Term Government Bonds	0.003188
Long Term Corporate Bonds	0.006932

Chapter 6

Conclusion

The environment for retirement planning has changed drastically in the past few decades. Guaranteed benefits, once offered by the majority of employers, are now being replaced by defined contribution plans. These plans allow employees to choose how to invest their contributions, but also place the financial responsibility and risk on their shoulders. The retirement safety net for many Americans, Social Security, may be facing issues of solvency in the near future. It is projected that Social Security funds will be depleted by 2037, and then only a percentage of benefits will be able to be paid. Life expectancy has been on the rise, allowing retirees to live longer. This places more strain on Social Security, and also requires people to plan for a longer retirement.

In light of these events, retirement benefit adequacy has been the focus of millions of people hoping to achieve retirement goals. In order to determine an asset allocation strategy suitable for one's needs, a cost for retirement must first be estimated. Three methods for estimation have been discussed in this paper: replacement ratios, minimum needs measures, and personalized cash flow forecast. While each method has its advantages and disadvantages, the calculations in this paper will be done using replacement ratios.

Once the cost has been established, an asset allocation strategy must be determined that will ultimately help attain the required funds. There are a myriad of possible allocation investments and strategies. This paper focused on large and small cap stocks, medium and long term government bonds, and long term corporate bonds. In choosing a strategy, the individual must reflect upon their own levels of risk tolerance as well as their time horizon. Diversification

is critical in limiting risk exposure of one's investments. Common allocation portfolios include conservative, moderate and aggressive approaches to investing, as well as target date funds which become more conservative as an individual gets closer to retirement age.

The projections in chapter 5 serve to show the impact of asset allocation on retirement assets. While it is beyond the scope of this study to go into complex allocation scenarios, the ones depicted can help guide people in the right direction. Most of the higher risk approaches, specifically those that involve higher percentages of assets invested in stocks produced a higher overall return. This is because in general, stocks have higher returns than bonds, especially over longer periods of time. However, this should not encourage people to invest entirely in equities. Further analyses show that variation in stocks is significantly higher than in bonds. Projections showed potential losses of near 40 percent in just one year due to high risk allocation strategies. According to results, it is good for individuals with a long time horizon to choose a more aggressive asset allocation strategy. If they are closer to retirement, then their time horizon is short and the additional gain from investing heavily in stocks is overshadowed by the huge losses that could happen, which is why glide paths in Target Date funds get more conservative as workers approach retirement age. Whether that individual wants to invest more conservatively towards retirement age depends on their level of risk tolerance and how much money is in their fund.

In order to retire comfortably, it is essential to define retirement goals and make plans to achieve them. Choosing the correct asset allocation strategy could mean the difference between an enjoyable and an underfunded retirement.

Appendix A
Historical Rates

Year	Large Cap Stocks	Small Cap Stocks	LT Corp Bonds	LT Govt Bonds	MT Govt Bonds	US T-bills	Inflation	Nominal Wages (numbers in red are estimates)
1926	11.60%	0.30%	7.40%	7.80%	5.40%	3.30%	-1.50%	-0.50%
1927	37.50%	22.10%	7.40%	8.90%	4.50%	3.10%	-2.10%	-1.10%
1928	43.60%	39.70%	2.80%	0.10%	0.90%	3.60%	-1.00%	0.00%
1929	-8.40%	- 51.40%	3.30%	3.40%	6.00%	4.80%	0.20%	1.20%
1930	- 24.90%	- 38.20%	8.00%	4.70%	6.70%	2.40%	-6.00%	-5.00%
1931	- 43.30%	- 49.80%	-1.90%	-5.30%	-2.30%	1.10%	-9.50%	-8.50%
1932	-8.20%	-5.40%	10.80 %	16.80%	8.80%	1.00%	- 10.30%	-9.30%
1933	54.00%	142.90 %	10.40 %	-0.10%	1.80%	0.30%	0.50%	1.50%
1934	-1.40%	24.20%	13.80 %	10.00%	9.00%	0.20%	2.00%	3.00%
1935	47.70%	40.20%	9.60%	5.00%	7.00%	0.20%	3.00%	4.00%
1936	33.90%	64.80%	6.70%	7.50%	3.10%	0.20%	1.20%	2.20%
1937	- 35.00%	- 58.00%	2.80%	0.20%	1.60%	0.30%	3.10%	4.10%
1938	31.10%	32.80%	6.10%	5.50%	6.20%	0.00%	-2.80%	-1.80%
1939	-0.40%	0.40%	4.00%	5.90%	4.50%	0.00%	-0.50%	0.50%
1940	-9.80%	-5.20%	3.40%	6.10%	3.00%	0.00%	1.00%	2.00%
1941	- 11.60%	-9.00%	2.70%	0.90%	0.50%	0.10%	9.70%	10.70%
1942	20.30%	44.50%	2.60%	3.20%	1.90%	0.30%	9.30%	10.30%
1943	25.90%	88.40%	2.80%	2.10%	2.80%	0.40%	3.20%	4.20%
1944	19.80%	53.70%	4.70%	2.80%	1.80%	0.30%	2.10%	3.10%
1945	36.40%	73.60%	4.10%	10.70%	2.20%	0.30%	2.30%	3.30%
1946	-8.10%	- 11.60%	1.70%	-0.10%	1.00%	0.40%	18.20%	19.20%
1947	5.70%	0.90%	-2.30%	-2.60%	0.90%	0.50%	9.00%	10.00%
1948	5.50%	-2.10%	4.10%	3.40%	1.90%	0.80%	2.70%	3.70%

1949	18.80%	19.80%	3.30%	6.50%	2.30%	1.10%	-1.80%	-0.80%
1950	31.70%	38.80%	2.10%	0.10%	0.70%	1.20%	5.80%	6.80%
1951	24.00%	7.80%	-2.70%	-3.90%	0.40%	1.50%	5.90%	4.70%
1952	18.40%	3.00%	3.50%	1.20%	1.60%	1.70%	0.90%	4.10%
1953	-1.00%	-6.50%	3.40%	3.60%	3.20%	1.80%	0.60%	6.40%
1954	52.60%	60.60%	5.40%	7.20%	2.70%	0.90%	-0.50%	0.80%
1955	31.60%	20.40%	0.50%	-1.30%	-0.70%	1.60%	0.40%	4.70%
1956	6.60%	4.30%	-6.80%	-5.60%	-0.40%	2.50%	2.90%	7.70%
1957	- 10.80%	- 14.60%	8.70%	7.50%	7.80%	3.10%	3.00%	3.00%
1958	43.40%	64.90%	-2.20%	-6.10%	-1.30%	1.50%	1.80%	1.30%
1959	12.00%	16.40%	-1.00%	-2.30%	-0.40%	3.00%	1.50%	5.80%
1960	0.50%	-3.30%	9.10%	13.80%	11.80 %	2.70%	1.50%	3.31%
1961	26.90%	32.10%	4.80%	1.00%	1.90%	2.10%	0.70%	1.42%
1962	-8.70%	- 11.90%	8.00%	6.90%	5.60%	2.70%	1.20%	4.68%
1963	22.80%	23.60%	2.20%	1.20%	1.60%	3.10%	1.70%	2.89%
1964	16.50%	23.50%	4.80%	3.50%	4.00%	3.50%	1.20%	4.64%
1965	12.50%	41.80%	-0.50%	0.70%	1.00%	3.90%	1.90%	2.51%
1966	- 10.10%	-7.00%	0.20%	3.70%	4.70%	4.80%	3.40%	5.69%
1967	24.00%	83.60%	-5.00%	-9.20%	1.00%	4.20%	3.00%	5.49%
1968	11.10%	36.00%	2.60%	-0.30%	4.50%	5.20%	4.70%	6.39%
1969	-8.50%	- 25.10%	-8.10%	-5.10%	-0.70%	6.60%	6.10%	6.73%
1970	4.00%	- 17.40%	18.40 %	12.10%	16.90 %	6.50%	5.50%	4.94%
1971	14.30%	16.50%	11.00 %	13.20%	8.70%	4.40%	3.40%	5.14%
1972	19.00%	4.40%	7.30%	5.70%	5.20%	3.80%	3.40%	7.28%
1973	- 14.70%	- 30.90%	1.10%	-1.10%	4.60%	6.90%	8.80%	6.76%
1974	- 26.50%	- 20.00%	-3.10%	4.40%	5.70%	8.00%	12.20%	7.43%
1975	37.20%	52.80%	14.60 %	9.20%	7.80%	5.80%	7.00%	6.53%
1976	23.80%	57.40%	18.70 %	16.80%	12.90 %	5.10%	4.80%	8.29%
1977	-7.20%	25.40%	1.70%	-0.70%	1.40%	5.10%	6.80%	6.85%
1978	6.60%	23.50%	-0.10%	-1.20%	3.50%	7.20%	9.00%	12.90%
1979	18.40%	43.50%	-4.20%	-1.20%	4.10%	10.40 %	13.30%	9.44%

1980	32.40%	39.90%	-2.80%	-4.00%	3.90%	11.20 %	12.40%	7.00%
1981	-4.90%	13.90%	-1.20%	1.90%	9.50%	14.70 %	8.90%	9.91%
1982	21.40%	28.00%	42.60 %	40.40%	29.10 %	10.50 %	3.90%	6.82%
1983	22.50%	39.70%	6.30%	0.70%	7.40%	8.80%	3.80%	4.32%
1984	6.30%	-6.70%	16.90 %	15.50%	14.00 %	9.90%	4.00%	6.78%
1985	32.20%	24.70%	30.10 %	31.00%	20.30 %	7.70%	3.80%	4.90%
1986	18.50%	6.90%	19.90 %	24.50%	15.10 %	6.20%	1.10%	4.84%
1987	5.20%	-9.30%	-0.30%	-2.70%	2.90%	5.50%	4.40%	4.34%
1988	16.80%	22.90%	10.70 %	9.70%	6.10%	6.40%	4.40%	5.23%
1989	31.50%	10.20%	16.20 %	18.10%	13.30 %	8.40%	4.70%	3.99%
1990	-3.20%	- 21.60%	6.80%	6.20%	9.70%	7.80%	6.10%	5.33%
1991	30.60%	44.60%	19.90 %	19.30%	15.50 %	5.60%	3.10%	2.91%
1992	7.70%	23.40%	9.40%	8.10%	7.20%	3.50%	2.90%	4.92%
1993	10.00%	21.00%	13.20 %	18.20%	11.20 %	2.90%	2.80%	1.97%
1994	1.30%	3.10%	-5.80%	-7.80%	-5.10%	3.90%	2.70%	3.47%
1995	37.40%	34.50%	27.20 %	31.70%	16.80 %	5.60%	2.50%	4.73%
1996	23.10%	17.60%	1.40%	-0.90%	2.10%	5.20%	3.30%	3.99%
1997	33.40%	22.80%	13.00 %	15.90%	8.40%	5.30%	1.70%	5.62%
1998	28.60%	-7.30%	10.80 %	13.10%	10.20 %	4.90%	1.60%	6.07%
1999	21.00%	29.80%	- 7.40%	-9.00%	- 1.80%	4.70%	2.70%	4.87%
2000	-9.10%	-3.60%	12.90 %	21.50 %	12.60 %	5.90%	3.40%	6.11%
2001	- 11.88%	22.77%	10.65 %	3.70%	7.62%	3.83%	1.55%	1.97%
2002	- 22.10%	- 13.28%	16.33 %	17.84 %	12.93 %	1.65%	2.38%	0.68%
2003	28.70%	60.70%	5.27%	1.45%	2.40%	1.02%	1.88%	2.52%
2004	10.89%	18.39%	8.72%	8.51%	2.25%	1.20%	3.26%	4.69%
2005	4.91%	5.69%	5.87%	7.81%	1.36%	2.98%	3.42%	3.72%
2006	15.79%	16.17%	3.24%	1.19%	3.14%	4.80%	2.54%	4.74%

2007	5.49%	-5.22%	2.60%	9.88%	10.05 %	4.66%	4.08%	4.48%
2008	- 37.00%	- 36.72%	8.78%	25.87%	13.11 %	1.60%	0.09%	2.23%
2009	26.46%	28.09%	3.02%	- 14.90%	-2.40%	0.10%	2.72%	-1.47%
2010	15.06%	31.26%	12.44 %	10.14%	7.12%	0.12%	1.50%	2.62%
2011	2.11%	-3.26%	17.95 %	28.23%	9.46%	0.04%	2.96%	2.68%
2012	16.00%	18.24%	10.68 %	3.31%	2.07%	0.06%	1.74%	2.32%

BIBLIOGRAPHY

- The 2012 Annual Report of the Board of Trustees.* Rep. Ssa.gov, 25 Apr. 2012. Web. 6 Apr. 2014.
- "401k Asset Allocation." *401k Asset Allocation - 401khelpcenter.com.* N.p., n.d. Web. 06 Apr. 2014.
- Aon Consulting. *Replacement Ratio Study.* Rep. Aon Consulting, 2008. Web. 6 Apr. 2014.
- Aon Hewitt. *2012 Retirement Income Adequacy at Large Companies.* Rep. Aon Hewitt, 2012. Web. 6 Apr. 2014.
- Bajtelsmit, Vickie. *Measures of Retirement Benefit Adequacy: Which, Why, for Whom, and How Much?* Rep. Society of Actuaries, Jan. 2013. Web. 6 Apr. 2014.
- Carther, Shauna. "Achieving Optimal Asset Allocation." *Investopedia.* N.p., 16 Nov. 2013. Web. 06 Apr. 2014.
- Geisel, Jerry. "Fewer Employers Offering Defined Benefit Pension Plans to New Salaried Employees." *Workforce.* N.p., 3 Oct. 2012. Web. 05 Apr. 2014.
- Goss, Stephen C. *The Future Financial Status of the Social Security Program.* Rep. Ssa.gov, 2010. Web. 6 Apr. 2014.
- Helman, Ruth. *2011 Risks and Process of Retirement Survey Report.* Rep. Society of Actuaries, n.d. Web.
- Ibbotson, Roger. *The True Impact of Asset Allocation on Returns.* Rep. N.p., Jan.-Feb. 2000. Web. 6 Apr. 2014.
- "Introduction to Retirement Planning." N.p.: n.p., n.d. N. pag. Theamericacollege.com. Web.
- Investopedia. "Asset Allocation." *Investopedia.* N.p., n.d. Web. 06 Apr. 2014.
- "The Last Private Industry Pension Plans : The Editor's Desk : U.S. Bureau of Labor Statistics." *U.S. Bureau of Labor Statistics.* U.S. Bureau of Labor Statistics, 3 Jan. 2013. Web. 06 Apr. 2014.

"Normal Retirement Age." *Normal Retirement Age (NRA)*. N.p., 9 Nov. 2009. Web. 06 Apr. 2014.

Sahadi, Jeanne. "Fixing Social Security: The 'low Hanging Fruit'" *CNNMoney*. Cable News Network, 11 May 2010. Web. 06 Apr. 2014.

Shapiro, Arnold. *Post-Retirement Financial Strategies from the Perspective of an Individual Who Is Approaching Retirement Age*. Rep. Society of Actuaries, Aug. 2010. Web. 6 Apr. 2014.

"Social Security." *Merriam-Webster*. Merriam-Webster, n.d. Web. 06 Apr. 2014.

SSA. "Life Expectancy for Social Security." *Social Security*. Social Security Administration, n.d. Web. 07 Apr. 2014.

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Jack Z. He

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ACTUARIAL EXAMINATIONS/VEE CREDITS

Exam 1/P: Passed, Score: 10	Probability	July 2012
Exam 2/FM: Passed, Score Pending	Financial Mathematics	Aug 2013
Exam 3/MLC: Sitting	Models of Life Contingencies	May 2014
VEE Courses: In Progress	Completed by end of semester	Dec 2013

EDUCATION

The Pennsylvania State University (University Park, PA) Class of May 2014

Schreyer Honors College Scholar: Undergraduate thesis in progress

Eberly College of Science:

Major: Statistics, *Actuarial Science Option* (B.S.)

Minor: Mandarin Chinese

WORK EXPERIENCE

Actuarial Intern – Retirement Consulting, Buck Consultants (Secaucus, NJ) *June 2013 – Aug 2013*

- Worked closely under the direction of a Senior Associate Mentor on real-life client assignments
- Prepared and reviewed data on Excel, ProVal, and Access for clients of various sizes (some 5000+)
- Demonstrated teamwork, leadership, and presentation skills by winning the summer intern project
- Participated in one-on-one discussions with Senior Directors and Principals on their areas of expertise
- Assisted in the preparation of government filings such as 5500 Schedule SBs and Valuation Reports
- Performed benefit calculations using Excel programs and information from client plan documents

Statistics Learning Assistant, Pennsylvania State University (State College, PA) *Jan 2012 – Present*

- Learned to portray statistical and technical concepts to students with little statistical background
- Held in-class and one-on-one review sessions for statistics labs, homework, and exams
- Improved communication skills by answering lab-related questions for classes of 80 students
- Administered exams, quizzes and labs alongside another teaching assistant

Minor League Baseball Cashier, Williamsport Crosscutters (Williamsport, PA) *June 2011 – Aug 2011*

- Improved communication skills by working closely with managers, customers, and co-workers
- Attained customer service skills by interacting with customers amid crowds of 4000+

McDonalds Crew Member (Williamsport, PA) *Aug 2009 – Jan 2010*

- Trained new hires on how to correctly and efficiently operate the different work stations
- Developed multi-tasking skills while working in a fast-paced and stressful atmosphere

ACTIVITIES

Actuarial Science Mentor, Actuarial Mentorship Program *Aug 2013 - Present*

- Responsible for answering actuarial major-related questions and concerns for five mentees
- Advised mentees on how to prepare for the career fair and helped review their resumes
- Reviewed and answered questions regarding exam P and FM material for mentees

Eberly Webmaster, Penn State Actuarial Science Club *Aug 2013 - Present*

- Designed, maintained, and updated the club's current webpage for Eberly actuarial students
- Raised over \$2000 for pediatric cancer research with the Actuarial Science Club THON organization

Geisinger Actuarial Shadowing Event, Geisinger Health Plan (Danville, PA) *June 2012*

- Interacted with health actuaries through hour long rotations, and witnessed their daily work
- Watched a presentation on business etiquette and tips on starting an actuarial career