FINANCIAL AND HEALTH SECURITY IN OLD AGE: THREE ESSAYS

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A dissertation submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Public Policy.

Chapel Hill
2012

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ABSTRACT

JEFFREY DIEBOLD: Financial and Health Security in Old Age: Three Essays
(Under the direction of John Scott)

This dissertation is composed of three essays that examine issues and policies related to the well-being of the elderly in the United States. Using a randomized control design, I demonstrate the relative strength of incentives structured as a credit as opposed to an economically equivalent deduction within the framework of a retirement-based annuitization decision. Next, I exploit the natural experiment provided by the establishment of Medicare Part D in 2006 to evaluate health-related outcomes affected by this policy change. I provide evidence that Medicare Part D resulted in a number of positive health-related outcomes among those Medicare beneficiaries without prescription drug coverage prior to enrolling in Part D. Finally, I test whether the financially literate are more likely to make decisions that minimize the risks to their financial security. The results from this analysis are decidedly mixed. Financially literate individuals do not, necessarily make better financial and investment related decisions but appear more active in the decision-making process.

To my wife and mother: for a lifetime of love, support, and encouragement.

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CHAPTER 1

CREDITS AND DEDUCTIONS: AN EXPERIMENTAL TEST OF THE RELATIVE STREGNTH OF ECONOMIC INCENTIVES

Introduction

Social policy in the United States has undergone an important transformation in recent decades as policymakers have increasingly employed the tax code to promote a broad range of social goals and policy objectives (Howard 1997; Howard 2007). This form of social policy is comprised of provisions within the tax code that provide credits, deductions or exclusions that serve as incentives for behaviors thought to socially desirable. Unlike the social policies such as Head Start, Medicare, or Temporary Assistance for Needy Families that are funded through direct expenditures and are, typically, administered by government agencies, these "tax expenditures" represent foregone revenue resulting from those reductions in the tax liability of qualifying households. Tax expenditures provide an economic incentive to engage in the behaviors they subsidize by allowing the household to reduce their tax burden and increase their after-tax income.

Among the largest of the tax expenditures in the tax code are the mortgage interest deduction, the Earned Income Tax Credit (EITC), and the exclusion of income contributed to individual pension plans. These provisions are designed to subsidize, respectively, home ownership, work (among low-income persons), and saving for retirement in an effort to encourage these behaviors. According to the Joint Committee on Taxation (JCT) (2010), the

revenue losses from individual households in 2010 due to these provisions within the tax code were $91 billion, $56 billion, and $105 billion, respectively.

Just as it is important to study if conventional policies have their intended effect and how current practices can be improved upon for better outcomes, it is equally important to apply these same empirical questions to the study of tax expenditures. Currently, most research has been devoted to establishing whether these programs are effective at encouraging the behaviors they subsidize and the results from the empirical work in this field are decidedly mixed.

The findings of this paper are intended to contribute to the debate over how best to encourage behavior through the tax code. Recognizing that the tax code is now indelibly linked to social policy in the United States, the benefits from such an analysis are twofold. First, this study will help determine whether tax credits may be more effective at increasing the rate at which individuals would engage in socially desirable behavior because, contrary to economic theory, experimental evidence indicates that individuals respond differently to alternative, yet economically equivalent, incentives. Second, this understanding will help establish how lawmakers can best apply the limited resources available to them. Meaning, if one type of tax expenditure is more effective at encouraging the behavior it is intended to subsidize, then by shifting resources into the most effective type of incentive policymakers can effectively and efficiently achieve their policy aims.

Tax Expenditures, Social Policy, and Behavioral Models

The earned income tax credit (EITC) provided $55 billion to 25.7 million working families with low-income in 2009 (JCT 2010). This provision within the tax code is currently the largest source of cash-assistance for the working poor and is the nation’s primary

antipoverty program (Gitterman 2010). Research has demonstrated that this program has been successful at increasing workforce participation among single mothers and reducing US poverty rates among the working poor (Eissa and Liebman 1996; Meyer and Rosenbaum 2000; Sherman 2009; Ben-Shalom, Moffit, and Scholz 2011; Hotz and Scholz 2006).

The mortgage interest rate deduction (MID) provided more than 34 million households with more than $91 billion worth of tax benefits in 2009 (JCT 2010). This subsidy is intended to promote homeownership which is thought to be associated with a number of positive externalities and socially beneficial outcomes. Despite being larger in terms of total benefit than the EITC, the empirical evidence indicates that this subsidy has had little to no effect on the rates of homeownership within the US. Glaeser and Shapiro (2004) estimate that a one percent increase in the subsidy rate is associated with only a .0009 percent increase in the rate homeownership. In other words, the subsidy is going to people who would have engaged in the desired behavior even in the absence of the subsidy.

The federal government also allows for deductions and exclusions for income invested in a defined contribution plans and individual retirement accounts. These provisions, referred to hereafter as exclusions for plan contributions (EPC), are intended to incentivize retirement saving and thereby improve financial security in retirement for those covered under qualifying plans. According to estimates from the Joint Committee on Taxation (2010), US workers were able to save $69 billion in tax liabilities through contributions to their pension plan in 2010. Contributions to these plans are typically tax deferred, meaning that individuals are allowed to exclude them from their taxable income throughout their working lives, but must eventually pay taxes on them and any investment earnings when they withdraw them. Here again, the empirical evidence indicates that the incentives embedded

within the tax code fails to encourage new retirement savings (Engen, Gale, and Scholz 1996; Gale and Scholz 1994).

In summary, these examples taken from research on tax expenditures highlight the mixed success of social policies administered through the tax code. It is surprising, given the considerable loss of tax revenue, that the MID and EPC tax expenditures fail to encourage the desired behaviors. The failure of these deduction and exclusion provisions contrasts starkly with the apparent success of the less costly EITC. The existing literature analyzing the effects of tax expenditures has tended to focus, primarily, on whether a particular tax policy has an effect on individual behavior. By contrast, this analysis will attempt to understand why certain tax expenditures may be more effective than others at increasing the rate at which individuals engage in the subsidized behaviors. While there is no available literature on the topic known to this author, there is apparent interest in this line of research. William Gale (2011), recently testifying before the Senate Committee on Finance, advocated for the conversion of the EPC into a refundable tax credit in an effort to improve the incentives associated with retirement savings. The important implication underlying his testimony is that individuals may respond differently to similar incentives depending on how they are structured. According to economic theory, individuals should be indifferent between two options with equal expected values but individual economic behavior frequently deviates from the expectations of these models.

In a field experiment comparing the relative strength of offering a credit (cash rebate) or economically equivalent matching contributions, Saez (forthcoming) found that the matching contributions were more effective at increasing enrollment in and contributions to an individual retirement account (IRA). The credit and match were set at rates such that the

out-of-pocket costs associated with any contributions were identical for individuals in each group. Those offered a credit were more likely to enroll in an IRA by roughly 5 percentage points and contributed $153 more to their accounts after enrolling. In a related study, Davis and Millner (2006) compared the effect of matches and credits as price-reduction strategies on consumer decisions. In this study, the researchers offered participants either a refund or a matching incentive to purchase chocolate bars. Those participants that were offered a matching incentive for the purchase of candy bars purchased significantly more candy bars than those offered an economically equivalent rebate.

The evidence indicating that economic responses actually vary depending on the incentive structures has important implications for economic and social policy, including the subsidies provided by tax expenditures. If one form of tax expenditure is a more powerful incentive then the federal government may be able to restructure many of the existing tax expenditures to increase the economic behaviors they are designed to subsidize without increasing the present expenditure levels. This study intends to test this possibility by comparing the effect of a credit to that of a deduction with the expectation that offering a credit is a more effective means of motivating specific behaviors.

Why Credits Might be More Effective

Deductions, exclusions, and tax credits each reduce a qualifying household's tax liability in an effort to incentivize specific behaviors, but they accomplish this goal through different mechanisms: deductions and exclusions result in a reduction a taxable income and credits reduce tax liability and increase after-tax income. Economic theory suggests that the manner in which those subsidies are delivered should not matter as long as each incentive has an identical effect on a household's total income. The evidence from behavioral studies

indicates that individuals frequently violate this expectation and show that the strength of the incentive created by the subsidy of the different tax expenditures may depend on how that subsidy is delivered (Davis and Millner 2006; Saez Forthcoming). For example, while there is no evidence to suggest that the MID and EPC have encouraged the behaviors they subsidize, there is evidence that individuals have responded to other forms of similar incentives for these particular behaviors. A recent study by Goldman Sachs (2010) found that the first-time homebuyer's tax credit had a significant impact on home sales in 2008 and 2009. This temporary tax credit provided those purchasing their first home with a refundable tax credit of up to $8,000 and is estimated to have increased home values by 5 percent and to have led to 400,000 additional home purchases in 2009 (Goldman Sachs 2010). Matched contributions and matching rates also appear to have a significant effect on participation in and contributions to individual retirement accounts (Duflo, Gale, Liebman, Orszag, and Saez 2006). However, the size of the effect of the Saver's Tax Credit, a non-refundable tax credit that reduces the tax liability up to 50 percent of contributions to a defined contribution plan of qualifying households, appears to be small (Duflo. Orszag, Gale, Saez, and Liebman 2007). The literature has established that economically equivalent incentives do not always elicit equal behavioral responses, but the evidence that credits are more effective than deductions or exclusions is merely suggestive. This analysis will attempt to test this possibility more directly but it is important, first, to explore the possible reasons why equally valued incentives may not elicit equal behavioral responses.

The expectation in economic theory of equivalent behavioral responses to economically equivalent incentive schemes is predicated on the assumption that individual economic behavior and choices are the result of rational actors weighing the available

options carefully according to expected benefits and then choosing the option that will maximize their gain or utility. Under this framework, individuals are assumed to be indifferent between two options with equivalent expected benefits. Applying these principles to tax expenditures, the effect of the incentive on the willingness of individuals to engage in the behavior being subsidized should be equal when the benefits from the two different subsidies are equal. In other words, individuals should be equally motivated by two different tax incentives as long as the incentives are equal in value. So, for example, an individual considering whether to purchase a home should be equally motivated by a tax credit of $10,000 or being able to deduct up to $10,000 off their taxes over ten years assuming, for simplicity, zero inflation, zero interest rates, and a discount rate of zero. However, there are a number of reasons to doubt that equal incentives will produce equivalent responses.

Deductions and exclusions such as the MID and EPC may have a higher compliance cost than tax credits like the EITC and compliance costs are thought to be an important determinant in the effect of a program (Bertrand, Mullainathan, and Shafir 2006). The complexity of the tax code confounds an easy estimation of one's expected benefit and confusion or incomplete knowledge may prevent individuals from being able to incorporate any expected benefit from the subsidies into their economic decisions. As a recent article in the USA Today makes clear, there is general confusion, even among purported tax professionals about the difference between the marginal and effective tax rate.[1] The article incorrectly claimed that workers receiving a pay raise may actually end up with less take-home pay after being "bump[ed] into the next tax bracket." Survey evidence suggests that such confusion is widespread among the general population. Further, a study by Fuiji and

[1] The article was written by Gregory Connelly (2011) and the USA Today has since issued a correction.

Hawley (1988) found that a large portion of the population could not guess or correctly identify their marginal tax rate. Without this knowledge, individuals cannot accurately estimate the amount by which these subsidies reduce their annual tax liability. This also provides a reasonable explanation for why wage earners and those with positive taxable income do not bunch into kink points at the various income tax brackets (Saez 2010; Chetty and Saez 2009). This finding is true over time as well, even when the increase in the marginal rates have been large and stable (Saez 2010). While applying for the EITC does not depend on whether one itemizes their deductions or require meticulous record keeping, this program, like the MID and EPC, has multiple and complex eligibility requirements and benefit schedules. Survey results indicate that workers are aware of the existence of the EITC but are not knowledgeable with respect to the structure of the EITC (Phillips 2001; Romich and Weisner 2002; Smeeding, Phillips, and O'Conner 2000; Maag 2005). This might explain why wage earners fail to bunch around the kink points at the phase-in and phase-out ranges of the EITC benefit schedule (Saez 2010; Chetty and Saez 2009).

The lack of a behavioral response to the MID and EPC tax subsidies may also be a function of the type of households that are able to make the most of these particular provisions. Deductions and exclusions reduce the amount income that falls under an individual's marginal rate of taxation and, therefore, provide a larger benefit to higher income households that, typically, face higher marginal rates. As a result, these provisions provide only a small subsidy to the vast majority of income earners and a larger benefit to high-income households.[2] The small subsidy implies that these programs provide only a weak incentive for engaging in the subsidized behavior. Moreover, a household can only

[2] In 2009, 80 percent of tax payers faced a marginal rate of taxation of 15 percent, the rate applied to income below (Tax Policy Center 2011). http://www.taxpolicycenter.org/taxfacts/displayafact.cfm?Docid=262

claim benefits like the mortgage interest deduction if they itemize their deductions on their income tax returns. Tax filing data indicate that outside of the high-income earners, only a small minority of taxpayers itemize their deductions (Prante 2007). Almost all of the wealthy, however, do itemize their deductions and received a disproportionate share of the benefits from these subsidies. For example, in 2009, 69 percent of all the benefits from the MID went to the 20 percent of US households making more than $100,000 (Joint Committee on Taxation 2010).[3] Higher income households may be predisposed to the types of behavior the government is attempting to encourage through these types of tax expenditures. This would help explain the imperceptible effect of these programs on the propensity of consumers to engage in the subsidized behaviors and would suggest that the these programs are functioning more as an unexpected reward for high-income households than as an incentive for these behaviors for those at lower points along the income distribution.

Finally, behavioral responses to these tax subsidies may vary due to psychological biases such as prospect theory a descriptive framework of individual decision-making under risk and uncertainty developed by Kahneman and Tversky (1979). One of the central tenets of this theory is that individuals tend to prefer a benefit that is certain over a larger benefit that is not certain. This tendency is referred to as the "certainty effect" and may help explain why individuals tend to heavily discount future benefits, meaning that they value present benefits higher than future benefits (Laibson 1997). Indeed, research has shown that when given the choice between a larger benefit paid out over time and a smaller lump sum benefit, individuals tend to prefer the lump sum (Pleeter and Warner 2001; Loewenstein and Prelec

[3] http://www.census.gov/hhes/www/cpstables/032010/hhinc/toc.htm

1992). Researchers have defined this type of impatience as hyperbolic discounting (Laibson 1997).

The evidence establishing the certainty effect and hyperbolic discounting imply that deductions and exclusions may be less effective at incentivizing the behavior due to the uncertainty they engender. As Fuiji and Hawley (1998) demonstrated, many people are confused about their marginal tax rate which would complicate any effort on the part of the individual to estimate the actual size of any benefit they might expect from any one particular deduction or exclusion. Even well-informed individuals will have to account for an uncertain future (e.g. mortality or income level) in their estimation of the present value of any total benefit they might expect to receive from, say, the MID. For example, an individual must incorporate the probability that he/she will make enough in the future to justify itemizing their deductions, accurately forecast future rate of taxation they may face, and accurately forecast the value of any other deductions they intend to claim in the future.[4] These factors introduce variation and uncertainty into expected present value of tax deductions, a problem that not shared by tax credits that reduce a tax bill dollar-for-dollar and may even be refundable, meaning that the household is paid the residual amount of the credit after their tax liability has been reduced to $0.

Finally, the ability to structure benefits from a credit as an immediate windfall may also make credits a more effective incentive than the stream of benefits typically provided by deductions and exclusions. For example, the first-time buyer tax credit may have be more effective at increasing the number of homes purchased in the U.S. than the MID because it

[4] Individuals would need to know the value of any other deductions because the value of any one deduction is not simply the value of the deduction multiplied by the marginal tax rate, it is equivalent to its share of all deductions multiplied by the average tax rate on all of the deducted income. This is true because all deductions are not factored in any particular order.

provided homebuyers with a one-time, fixed windfall rather than a stream of uncertain benefits issued over time. In a natural experiment involving substantial sums of money, Warner and Pleeter (2001) demonstrate the value that individuals place a large premium on the present gains. They illustrate the behavioral tendency towards hyperbolic discounting and show that individuals overwhelming prefer a smaller immediate to a larger gain paid out over time. The idea that individuals value something they can obtain immediately is related to the certainty effect because delaying an outcome is equivalent to making it uncertain. The effect of having something with certainty and having something immediately simply reinforce one another and weight the likelihood in favor of a credit being a stronger incentive than a deduction.

This study expects to find that a credit is a more powerful incentive for encouraging specific behaviors. Therefore, it is expected that the rates of annuitization will be higher among those offered a credit than an actuarially equivalent deduction.

Hypothesis 1: Participants will be more likely to select an annuity when receiving a credit versus a deduction with an equal expected value.

Hypothesis 2: Participants will be more likely to select an annuity when receiving a credit even when the expected value of the deduction exceeds that of the credit.

Why Annuities

This study uses the decision to purchase an annuity as the context in which to analyze whether and how individuals respond differently to equivalent economic incentives. The incentives in this study are designed to replicate existing tax expenditure policies but because the results are derived from a game-based computer simulation, this study is limited in what it can say about the effect that these incentives might have on actual annuitization behavior.

However, there were important reasons behind the decision to base the experiment on the annuitization decision.

First, according to the standard life-cycle model, individuals would realize significant welfare gains were they to annuitize some, or all of their retirement savings (Yaari 1965; Mitchell 2001; Dushi and Webb 2004; Mitchell, Poterba, Warshawsky, and Brown 1999; Davidoff, Brown, and Diamond 2005). Despite the theoretical and estimable gains that economic theory and literature suggest might flow from such a decision, very few individuals elect to annuitize their assets (Investment Company Institute 2011; Mottola and Utkus 2007). For this reason, it is the type of economic behavior that policymakers may have an interest in subsidizing. In fact, legislation was introduced before Congress in 2009 that would have modified the tax code and established a new tax expenditure that would have allowed individuals to exclude 50 percent of any income from an annuity contract.[5]

Second, a growing number of researchers have used games to simulate the annuitization decision within an experimental setting to study various dimensions of the annuitization decision as well as various behavioral biases that violate or confirm basic economic theories and expectations. Two such studies were conducted recently by Agnew, Anderson, Gerlach, and Szykman (2008) and Gazzale and Walker (2009). Agnew et al (2008) found that the annuitization decision is sensitive to positive and negative framing. That is, individuals were exposed to information highlighting the benefits of annuities (positive framing), they were more inclined to purchase them than those exposed information highlighting the risks associated with them (negative framing). Gazzale and Walker (2009) found that individuals were more likely to purchase an annuity when their benefits were

[5] See H.R. 2748, The Retirement Security Needs Lifetime Pay Act of 2009.

specified as a stream of payments rather than a lump-sum prior to playing the game, implying that individuals anchor themselves to a specific way of thinking about their benefits and are more likely to annuitize because an annuity reinforces their original conceptualization of their benefits. They also found evidence indicating that the annuization decision is negatively affected by the sequential nature of the risk associated with survival (survival to period 15 require survival to period 14, which requires survival to period 13, and so forth) to which the stream of benefits from an annuity are linked.

This study will borrow the relevant game design of these previous studies in an effort to determine whether individual behavior deviates from the expectations of common economic models and offer ideas about how policy might be better designed to exploit these tendencies.

Data and Methods

Unlike many other types of programs and policies, there is a limited number of means by which tax expenditures may be implemented through the tax code (credit, deduction, or exclusion), yet little is known about the relative effectiveness of each type of expenditure. It is possible that the failure or success of these different provisions is a function of how the incentives are structured. Using an experimental design, this analysis will test whether the effect of a tax benefit depends on how it is structured. This study helps establish whether tax expenditures are incentivizing individuals to initiate certain behaviors rather than simply rewarding individuals for behavior they would have otherwise engaged in the absence of an incentive.

The experiment was designed as a game that simulates one of the many economic decisions confronting those entering retirement: whether to insure against the risk of

outliving their assets (longevity risk) by purchasing an annuity with a portion of the account balance each player was given at the start of the game. Individuals were randomly assigned to receive incentives modeled after the type of tax expenditures typically used to subsidize socially desirable economic behavior: tax credits and tax deductions. The purpose of the incentives was to encourage annuitization within the game but the research aim is to study whether and how rates of annuitization vary between individuals assigned to the different treatment groups, when the value of the incentives are equal.

The rates of annuitization are compared between three mutually exclusive groups to determine 1) whether tax subsidies can increase the rates of annuitization among individuals and 2) whether those offered a tax credit were more likely to annuitize than those offered the tax deduction.

Game Structure

To test the hypotheses, study participants played a computer-based game and were randomly assigned to either condition A (Credit), B (Equal Deduction), or C (Larger Deduction). Their assignment to either A, B, or C determined the type incentive they were offered to purchase an annuity but otherwise, the game was identical across conditions.

The participants were then informed of the rules of the game. They were told that would have to make decisions related to their account before the game began and that once made, these decisions would be binding throughout the game.[6] They were informed that they would begin the game with $20,000 in their account and that they were to "live off" this money throughout the game. They were then told that their compensation for participating would be determined by the balance in their account when they exit the game. The higher

[6] They were binding because we wanted to make sure that the annuitization decision was affected only by the incentive offered and not by the changes in the account balance due to, say, market losses.

their account balance when their game ended, the higher their compensation. It was then explained that the game would take place of multiple periods, and that in each period, $3,000 would be deducted from their accounts, an amount set to represent cost of living expenses. They were then told that they would have opportunity to invest their funds in three different investment options. They were then informed that game would end if they ran out of money in their account or if they fail to "survive" to the next period.

Participants then learned the parameters determining survival which was determined randomly. The computer performed this function automatically by generating a random number between 1 and 18. Individuals with a value larger than the specified number survived to the next period. The value necessary to survive increased with each period, so the likelihood of survival declined over time. In each subsequent stage the value needed to survive increased by one. For example, an individual needed a value of four or higher to survive to the second stage and then a value of five or higher to survive to the third stage, a value of six in order to survive to the fourth stage, and so forth. Individuals were able to see the conditional probabilities of their survival to a given period in the "life table" provided to them at the beginning of the game.

Individuals were then given detailed information about the investment options in the game. They had the option of investing some or all of their money in (1) a fictional stock market, (2) purchasing an annuity to help offset their $3,000 per-period costs of living expenses, or (3) leaving their money in their account or some combination of the available options. The cost of the annuity was $13,110 and the amount of the per-period annuity payment was $2,000 (applied to the account balance). Returns in the stock market would be

due entirely to chance and any remaining amount they chose not to invest from their account would not gain or lose value except for the automatic deduction of the cost of living.

On this same screen individuals could elect to purchase an annuity but depending on the group to which the participant was assigned, individuals received different information regarding the purchase of the annuity. Individuals assigned to the credit group would receive a credit of $3,277 applied towards their account balance if they purchased an annuity. Those that were assigned to the deduction group would see their cost of living reduced by $500 in each period if they purchased an annuity (Equation 1). Those that were assigned to the group offered the deduction that was larger than the credit were told that their cost of living would be reduced by $875 in each period if they purchased the annuity (Equation 2). The individuals indicated whether they wanted to purchase the annuity by answering "yes" (or "no") to the question: "Would you like to purchase the annuity?" The expected value of the deduction is given by the following equation:

$$EV(Equal\ Deduction) = \sum_{t=1}^{t}(p_t * \$500) = \$3{,}277 = Credit \qquad \text{Eq. 1}$$

$$EV(Larger\ Deduction) = \sum_{t=1}^{t}(p_t * \$875) = \$4{,}855 > Credit \qquad \text{Eq. 2}$$

where *p* is equal to the conditional probability of surviving to time period *t*.

The deduction is intended to reduce the per-period "cost of living" of the participant just as tax deductions reduce the annual costs associated with the behaviors they subsidize. The values of the deductions were set to equal roughly $\frac{1}{6}$ and $\frac{2}{7}$ of the per-period cost of living in the game for the group and offered the equivalent and larger deductions, respectively. These values are, admittedly, arbitrary but these types of simplifications are unavoidable in a

game simulating life experiences.[7] The total value of the deduction for the game was set to equal that of the credit after being weighted by the survival probabilities.

Under this framework the deduction represents a decrease in the per-period cost-of-living for the individual and the credit represents a one-time benefit issued in the period that the annuity was purchased. The game parameters with respect to the treatment conditions are intended to capture how each of these tax expenditures might operate in the real-world. While some tax expenditures can be claimed on an annual basis such as the EITC, the focus of this study is limited to the one-time credits. I structured the credit and deduction as such in order to heighten the contrast between the two as well as to simplify, as a practical matter, the operation of the game.

After the participant decides whether to purchase the annuity and how much to invest in the stock market, the game begins. Once they have made their annuitization and investment decisions, nothing more is required of the participant as the game proceeds automatically from period to period until the individual either runs out of money or exits when the randomly generated survival number is insufficiently large. Once the game is over, the amount remaining in the participant's account is used to determine their compensation for playing the game. Individuals were paid either $2, $5, or $10. They received $2 for exiting the game with a negative balance, $5 for exiting the game with a positive balance but below starting amount, and $10 for exiting the game with more than their the starting balance. After the participants finished playing the game, they filled out a brief survey that collected

[7] The value was selected primarily because it was the mid-point for acceptable range of possible values. The value had to be less than $1,000 and more than $0. This restriction ensures that individuals that purchase an annuity will still lose money from their account over time (Cost of Living = 3000 – 2000 – 500 = 500). This was to ensure that the project remained within the budget by not paying out too much too often to the participants.

demographic information and other data relevant to this study. Individuals are asked about their gender, age, race, marital status, employment status, education, and household size. They were also asked to provide information with respect to their primary pension plan and a question intended to elicit their level of risk aversion. The risk aversion question was a modified version of the same measure taken from the Health and Retirement Study (HRS).[8] After the individual finished filling out the survey information, they had concluded the study and they were given their compensation.

Participants consisted of 145 individuals from the Wake County jury pool in Raleigh, North Carolina. These individuals within the jury pool were selected randomly from country residents who were either licensed drivers or registered voters, or both. Those county residents that are excluded from jury duty include those individuals that are less than 18 years old, those that have served as a juror in the previous two years, those that do not speak English, felons that have not had their citizenship restored and those who are not physically or medically competent. Those individuals called for jury duty in the months between August 2011 and November 2012 were solicited to participate in this game as they waited in the jury lounge in the Wake County Courthouse in downtown Raleigh. The game was set up on one or more computers in the jury lounge. Those that agreed to participate were seated at one of the available computers to play the game.

There is no way to be sure that the sample size in this analysis is sufficiently large to justify claims of significance but a larger sample size is preferable, especially when the

[8] The risk aversion question asks the respondent to answer the following question: Suppose that you are the only income earner in the family. Your doctor recommends that you move because of allergies, and you have to choose between two possible jobs. The first would guarantee your current total family income for life. The second is possibly better paying, but the income is also less certain. There is a 50-50 chance the second job would double your total lifetime income and a 50-50 chance that it would cut it by a third. Which job would you take - the first job or the second job? This question is nearly identical to the HRS version.

treatment effects are thought to be small. As many participants as could be afforded were included in the study. Obviously, more participants are desirable but the group means appeared to have stabilized by the end of the data collection.

Estimation Methods

This analysis relies on two types of analysis: a two sample t-test and ordinary least-squares regression (OLS). The outcome in each of these analyses is a dichotomous variable indicating whether or not individuals made the decision to annuitize. The variables of interest are the dichotomous variables indicating whether the individual was assigned to the group offered a credit or an economically equivalent deduction and the dichotomous variable indicating whether the individual offered a credit or the group offered an economically larger deduction. These variables are analyzed separately.

T-tests are common with randomized designs but randomization creates only the expectation of equivalence between groups to which participants are assigned. Ordinary least-squares regression is used to control for differences that may exist between the groups across the demographic and control measures collected in the survey portion of the study. Because the outcome is dichotomous, the regression analysis is a linear probability model. A linear probability model with robust standard errors was used as opposed to a non-linear model to ease the comparison of the t-test and regression results. [9]

Descriptive Statistics

The summary statistics in Table 1 highlight some important aspects of the sample of game participants. What stands out most among the characteristics of the participants in this study is that an overwhelming majority of the sample had completed college. The highly

[9] Robust standard errors were used to account for heteroscedasticity in residuals.

educated sample reflects, in part, the population of Wake County. According to the Census Bureau, almost half of the residents in the county have a bachelor's degree compared with one quarter of the North Carolina population statewide.[10] Having a college education may also be associated with being a licensed driver or a registered voter, the pre-requisites for jury duty selection in the state. Finally, those that attended college may have been more willing to participate in a study linked with a local university. The relatively large number of college graduates in the study may limit the generalizability of these findings but jury pools are the easiest way to get access to a variety of potential participants. However, the more highly educated are more likely to have access to and participate in defined contribution plans (Engen, Gale, Scholz, Bernheim, and Slemrod 1994; Benjamin 2003). Therefore, the annuitization framework of this analysis may be more relevant to this segment of the population than to the general public. In sum, the benefit of having access to a broad range of individuals randomly sampled from the local population is strongly preferable to sampling undergraduates or employees of a particular firm, practices common among this type of experimental work but there are important differences between the sample and general population.

A majority of the sample are white and between the ages of 30 and 49. A large fraction of the participants are married, in the labor force, and covered by a pension which is not surprising given that highly educated individuals are over-represented in this sample. Most of those with a pension are covered by a 401(k), the predominant form of pension in the private sector (Department of Labor, 2010).

Results

[10] http://quickfacts.census.gov/qfd/states/37/37183.html

Figure 1 displays the levels of annuitization for each of the groups in this analysis. Clearly, annuitization was a popular option within the game. The high rates of annuitization across each of the groups stand in stark contrast to the low levels of demand in the actual annuity market in the United States. However, according to data from the American Council of Life Insurers (2011), the amount Americans invest in individual annuity contracts has increased over the past few years but the current demand is still well below what economic theory would predict (Yaari 1965; Mitchell 2001; Dushi and Webb 2004; Mitchell, Poterba, Warshawsky, and Brown 1999; Davidoff, Brown, and Diamond 2005). While this is an interesting and unexpected finding, the absolute levels of annuitization are not as relevant as are the relative rates of annuitization between the each of the credit and deduction conditions.

According to the data, a majority of those assigned to the credit condition and a substantial minority of those assigned to the deduction conditions opted to annuitize a portion of their account balance. Roughly 63 percent of those assigned to the credit condition annuitized their assets compared with 42 percent of those assigned to the credit-equivalent deduction condition and 43 percent of those assigned to the larger deduction condition.

This study poses two questions: First, is there a significant difference in the rate of annuitization across the groups assigned to receive a credit and those assigned to receive an economically equivalent deduction? Second, is there a significant difference in the rate of annuitization across the groups assigned to receive a credit and those assigned to receive deduction that economically larger than that of the credit? The results from the pairwise comparisons are displayed in Table 2.

Compared with the deduction group, those offered the credit were more likely to purchase the annuity. This was true regardless of whether the expected value deduction was

actuarially equivalent to the credit or whether the expected value of the deduction was larger than the credit. Being offered a credit increased the likelihood that an individual purchased an annuity by 21 percentage points over an actuarially equivalent deduction and 20 points over a deduction with a larger expected value. This change represents roughly a 50 percent increase in the rate at which individuals engaged in the subsidized behavior by simply moving from a deduction to a credit. The differences in the rates of annuitization between the credit group and each of the deduction groups were statistically significant at the .05 level.

While randomization provides the expectation of equivalence across the credit and deduction groups but it does not guarantee that there will be no measurable differences between the groups, especially in smaller sample sizes like those used in this analysis According to summary statistics in Table 1 there do appear to be some important differences across the credit and deduction groups. The credit group has a higher proportion of females and married participants than either of the deductions groups. The participants in the group offered the deduction with an economically equivalent credit tended to be less risk averse than any of the other groups and were less likely to be covered by a pension than participants in the other groups. To control for the effect these differences may have, these measures were included as control variables in a regression analysis comparing the rates of annuitization across the different groups. The results of this analysis are provided in Table 4.

The coefficients from the regression analysis indicate that the difference in the estimated effect of the credit relative to the deduction remains even after controlling for the differences between the two groups. The results from the first column compare the effect of being assigned to the credit condition on the likelihood of annuitization relative to those assigned to the actuarially equivalent deduction condition. The parameter of interest is on the

variable Credit & Equal Deduction which is variable indicating treatment assignment. This coefficient .27 which indicates that being assigned to the credit condition increases the rate of annuitization by 27 percentage points over being assigned to the actuarially fair deduction condition. This estimate is statistically significant and larger than the difference in the group means estimated for each group (Table 2). The second parameter of interest is the variable Credit & Larger Deduction which indicates whether an individual was assigned to the group offered the credit condition or the group offered the deduction with an actuarially larger value than the credit. Here again, the effect is positive, statistically significant and larger than the difference than the group means estimated in Table 2. The larger coefficients for the treatment effects suggest that the effect was suppressed by one or more of the variables omitted from a simple t-test of group means.

Discussion

The findings from this study clearly demonstrate that an incentive structured to resemble a credit is a more powerful incentive for encouraging a specific economic behavior than one designed as a deduction. This fact remains true even when the expected value of the deduction is larger than the credit. These results comport with the stylized facts about the measureable effects of the EITC on labor force participation and the lack of an empirical relationship between the MID and EPC on the economic behaviors they are intended to subsidize.

The types of tax subsidies analyzed in this experiment are important vehicles by which policymakers implement social welfare policies. In fact, spending on tax expenditures has grown at a rate comparable to direct spending programs over the past few decades (Howard 1997). At a point in time when policymakers are looking to trim long-term deficits,

understanding how these incentives can be structured to maximize their effectiveness and make the most efficient use of public resources is paramount from a policy perspective.

While this project focuses on the annuities specifically, the behavioral responses to the various incentive structures that underlie the reasons for these differences are relevant to a wider range of activities. The tax code is replete with rules granting favorable (and unfavorable) tax treatment to specific behaviors that the Congress intends to foster and sustain. If the purpose of tax expenditure subsidies is to increase the rate at which individuals engage the behavior that these policies are intended to subsidize, then the evidence from this analysis would suggest that the focus should shift away from deductions and exclusions and towards refundable tax credits as the results suggest that the government could get a larger behavioral response from a credit than it could with a higher valued, and more expensive, deduction. Opportunities to get more for less are rare, but with respect to tax expenditures, it appears possible.

Future studies looking at this issue may check to determine whether these results are robust when applied in a field experiment on annuitization and other types of economic behavior. It is also important to establish whether the strength of the incentive from a credit is moderated by the credit design—namely, whether the credit is refundable or non-refundable. In their review a tax credit designed to encourage retirement saving (the Saver's Credit), Duflo et al. (2006) conclude that complex design combined with non-fundability may explain the limited success of this incentive. Their work establishes that simply providing a credit as opposed to a deduction or exclusion will not ensure the success of the incentive, but that the structure of the credit matters. It would be useful for future work in this field to distinguish between more and less successful credit designs.

Tables and Figures

Table 1: Descriptive Statistics

	Credit Group	Deduction Group (Actuarially Equivalent)	Deduction Group (More Valuable)
Fraction Male	0.37	0.42	0.56
Fraction White	0.79	0.79	0.73
Fraction Married	0.82	0.66	0.67
Fraction Employed Full-time	0.78	0.76	0.85
Size of Household	2.99	2.84	2.77
Age			
18-29	0.09	0.05	0.05
30-39	0.24	0.13	0.41
40-49	0.35	0.37	0.33
50-59	0.22	0.21	0.13
60+	0.1	0.24	0.08
Education			
Some High School	0	0	0
High School	0.03	0.05	0
Some College	0.21	0.21	0.26
College or More	0.76	0.74	0.74
Fraction with a Pension	0.82	0.71	0.85
Fraction with Risk Averse	0.72	0.55	0.71
Fraction with a DC Plan	0.63	0.53	0.67
N =	68	38	39

Table 2: Pairwise Comparisons of Annuitization Rates

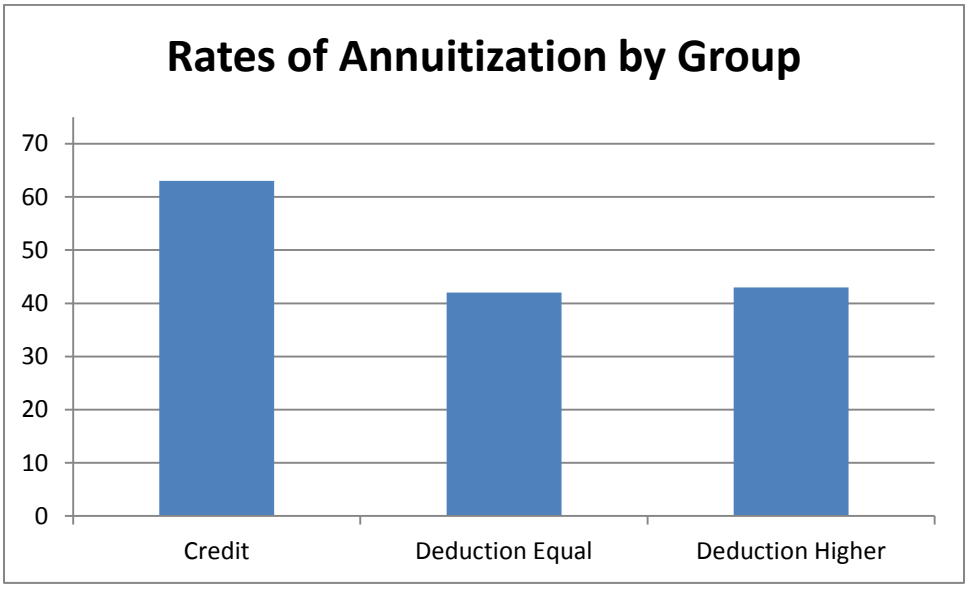
Pairwise Comparison	Hypothesized Difference in Rates of Annuitzation	Actual Difference	*p*-value
Credit and Equal Deduction	Avg(Credit) - Avg(Eq. Deduct) > 0	21.1	0.036**
Credit and Larger Deduction	Avg(Credit) - Avg(Lrg. Deduct) > 0	19.6	0.049**

Table 3: Comparison of Annuitization Rates by Group using OLS

	Outcome: Annuity (Yes=1; No=0)	
Credit (1) & Equal Deduction(0)	0.267**	
	-2.44	
Credit (1) & Larger Deduction(0)		0.217**
		-2.02
Married	0.092	0.134
	-0.69	-1.12
Risk Averse	-0.213*	-0.143
	(-1.93)	(-1.23)
Has a Pension Plan	-0.072	0.144
	(-0.52)	-1.11
Constant	0.537***	0.322*
	-2.73	-1.67
N	91	95

* p<.10 ** p<.05 ***p<.01
The t-scores are in parentheses.

Figure 1:



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CHAPTER 2

THE EFFECTS OF MEDICARE PART D ON HEALTH OUTCOMES AND EXPENDITURES

Introduction

In 2003, the Medicare Prescription Drug, Improvement, and Modernization Act (MMA) established an optional prescription drug component within the Medicare program, known as Part D. This new program was effective on January 1, 2006, at which point all Medicare-eligible individuals (those aged 65 and older or disabled) had the option of obtaining prescription drug coverage through Medicare. For the many Medicare beneficiaries without an existing prescription drug plan, Part D represented a unique opportunity to obtain prescription drug coverage. For others with existing prescription drug coverage, Part D represented an alternative to their current plan. Using two treatment groups composed of separate samples of Part D enrollees—those without prior coverage and those replacing their existing coverage with a Part D plan—and a control group of Medicare beneficiaries that had and maintained their pre-existing coverage, this analysis will estimate the effect of prescription drug coverage and Part D on the health and health care utilization among Medicare beneficiaries using a quasi-experimental research design.

Medicare Part D

The passage of MMA marked the largest expansion of Medicare since the program was created in 1965 and was widely viewed as a response by lawmakers to the rising demand for, and increasing cost of, prescription drug therapy. From 1994 to 2004, the price of

prescription drugs in the U.S. had increased an average of 8.3 percent per year, more than triple the average annual rate of inflation (Kaiser Family Foundation, 2005). Over same time span, the average number of prescriptions taken by Americans increased from 7.9 to 12.3 (Kaiser Family Foundation 2005). According to the Centers for Medicare and Medicaid Services, just prior to the implementation of Part D, the U.S. spent $201.7 billion dollars on prescription drugs in 2005, marking a 177 percent increase in prescription expenditure over the previous decade.[11] As Figure 1 illustrates, the cost of prescription drugs increased at the fastest rate in recent years compared to other major medical expenditures.

A primary objective of the Part D program was to reduce the costs associated with prescription drug therapy through the expansion of affordable access to drug coverage. High prices made prescription drug therapy cost prohibitive for many of those without access to prescription drug coverage or with less comprehensive forms of coverage. Prior to the establishment of Part D, between 20 and 30 percent of Medicare recipients lacked any prescription drug coverage (Safran et al. 2005; Neuman et al. 2007; Levy and Weir 2007). Despite their lack of drug coverage, more than one-third of these individuals reported taking five or more prescription medications in 2003. Uncovered Medicare recipients were more likely to have not filled a prescription, skipped doses, or taken smaller doses in an effort to defray their prescription costs than were those with coverage (Safran et al. 2005). Part D was an effort to reduce these forms of rationing and improve access to prescription drugs to these uncovered and under-covered individuals.

The rate at which Medicare recipients without prior coverage enrolled in the Part D program suggests that their coverage status may have been the result of market exclusion

[11] These figures represent the author's calculation using expenditure data 1995 to 2005 provided by the Centers for Medicare and Medicaid Services. The amounts are expressed in constant 2005 dollars.

rather than low demand. Approximately 61 percent of those without coverage in 2005, the year before Part D was implemented, enrolled in the program, reducing the proportion of uncovered Medicare beneficiaries from 33 to roughly 8 percent (Neuman et al. 2007; Heiss, McFadden, and Winter 2007). While no formal study shows why these individuals lacked prescription drug coverage prior to Part D, one can speculate that many were uncovered due to exogenous constraints such as a lack of a retirement health benefit and/or the high price of supplemental prescription drug coverage. Results from this study indicate that among the uncovered, those individuals who reported taking prescriptions regularly were most likely to enroll in a Part D plan when they became available. The enrollment of these individuals in Part D signifies the success of this program at reducing some of the barriers posed by costs and limited access to the drug insurance market.

There is also evidence to suggest that Part D plans were an attractive alternative for many of those individuals with preexisting coverage. Neuman et al. (2007) found that 46 percent of those enrolling in Medicare Part D in 2006 had coverage from another source in 2005. Again, one can only speculate as the exact reason but results from this study indicate that those with plans that covered less of their total prescription costs were more likely to substitute their existing coverage for a Part D plan. This finding implies that, for these individuals, plans within the Part D program were most likely to be less costly and/or more comprehensive.

Regardless of the group-specific reasons, the decision of the uncovered and covered, to enroll in a Part D plan may be interpreted as the revealed preference of the individuals within each group. Under this framework, the Part D enrollment decision represents the individual's maximization decision and allows for the expectation that their coverage will

result in positive health outcomes for both groups. In this paper, I estimate the effect of Part D prescription drug coverage on the health and health care utilization of individuals within each group.

Medicare Part D: The Natural Experiment

The establishment of the Part D program is useful for this analysis because of two key features. First, the establishment of the Part D program represented an exogenous shock to the availability of prescription drug insurance for Medicare beneficiaries. This change created a natural experiment that may be employed to control for possible selection bias and isolate the effect of Part D drug coverage on the health-related outcomes of those enrolled in the program. This study will use the variation in the availability of drug coverage generated by the establishment of Part D to analyze the effect of this program on health care utilization and health outcomes of two distinct groups of Part D enrollees: (1) those without prior drug coverage and (2) those substituting their existing coverage for a Part D drug plan. Each group will be used to estimate two similar, but separate treatment effects. The first group (Group 1) will be used to estimate the effect of prescription drug coverage by comparing those who signed up for coverage in contrast to those who had drug coverage prior to the establishment of Part D and maintained that drug coverage through 2008. The second group (Group 2) will be used to estimate the effect of the Part D program on the health-related outcomes employed in this study by comparing those who switched into Part D with those with retained their previous coverage. A third group of individuals that had and maintained their existing coverage from a private source will be used as a control group in a difference-in-difference research design. This technique imposes few key identifying assumptions and allows for a causal interpretation of the relationships found in the data.

Second, detailed data on the prescription drug coverage, health status, and health care utilization of individuals in each of these groups are available from the Health and Retirement Study (HRS), a longitudinal data set covering a large sample of those eligible for and enrolled in Medicare and Part D. Most importantly, the data employed in this analysis were collected in this survey both before and after the introduction of the Part D program allowing for difference-in-difference estimation. These data will be used to determine individual assignment to the treatment and control groups and to estimate the effect of the Part D program on the health outcomes available in the HRS. Assignment to the three groups—two treatment and one control group—will be determined by combining data on the respondents' prescription drug coverage status 2004, 2006 and 2008, two years prior to the implementation of Part D, and up to 3 years afterwards.

This study will include new as well as previously examined health-related outcomes from a data set that has not yet been applied to the analysis of the Part D program. In doing so, this paper makes two new contributions to the literature.

First, this analysis will argue that the previous study attempting to estimate the effect of Part D prescription drug coverage on health by Kaestner and Khan (2010) obscured this relationship by looking for health improvements using a composite index of physical limitations and a research design with limited statistical power. The medications most frequently prescribed to Part D enrollees are taken for preventative purposes with the intention of mitigating the health risks and symptoms associated with chronic health conditions (Hargrave, Hoadley, Cubanski, and Neuman 2009). Therefore, individual health is more likely to respond by stabilizing health declines rather than resulting in actual improvements. This paper argues that, given the advanced age of the elderly, the disability

status of the nonelderly eligible for Medicare, and the types of prescriptions most frequently taken by Part D enrollees, it is unlikely that increased access to prescription therapy through Part D would result in physical or functional improvements. Any health effect of Part D, therefore, is likely to operate through the mitigation of the current health declines rather than actual improvements in health. For this reason, this study will introduce a new measure of health changes, self-reported health declines, into the study of the health effects of Part D that is intended to more accurately capture and model the relationship between prescription drug therapy and individual health. In addition, the use of a weak instrument in the quasi-experimental analysis of Kaestner and Kahn (2010), which may have inflated the standard errors in the authors' two-stage least squares regression model, likely prevented them from detecting small effect sizes, a fact acknowledged by the authors. Again, the advanced age and physical condition of Medicare recipients may foreclose on the possibility that Part D would have a large effect on their health. Smaller effect sizes would have been imperceptible and mistaken for a lack of a significant effect in their analysis. This analysis will attempt to provide a more complete and precise estimation of the health effects of the Part D program using a new research design and by re-examining and expanding upon the health outcomes studied by Kaestner and Khan (2010).

Second, this will be the first study to isolate two distinct treatment effects on the health and health care utilization among Part D enrollees: (1) the effect of prescription drug coverage and (2) the effect of Part D program. The difference between these two effects is subtle but important. The first effect captures the Part D program's impact on those without prior prescription drug coverage (Group 1). The second distinguishes the effect that Part D has had on those who enrolled in the program with prior prescription drug coverage (Group

2). The existing literature has focused on the effect of Part D on the Group 1 and, until this point, has yet to explore the nature of the relationship between Part D and the health-related outcomes for Group 2. In order to understand the range of possible treatment effects resulting from the establishment of Part D, it is necessary to isolate and analyze each of the subpopulations enrolled in the program.

Literature Review

Though much research has been devoted to understanding and estimating the effect of health insurance on individual health and health care utilization, the study of prescription drug insurance on these outcomes has not garnered nearly as much attention. This discrepancy is likely due to the relatively recent emergence of prescription drug therapy as a primary treatment modality and the fact that prescription drug benefits are often subsumed within comprehensive health insurance plans. The available research in the prescription drug coverage field consistently demonstrates that obtaining prescription drug coverage leads to an increase in prescription drug use and declines in out-of-pocket prescription drug expenditures. There is no available evidence to suggest that prescription drug coverage results in improved health outcomes.

Health Insurance

The only large-scale randomized experiment to study the effects of health insurance coverage on individual health status and demand for medical services occurred in 1974 under the RAND Health Insurance Experiment (HIE). In the HIE, individuals were randomly assigned to different levels of insurance coverage that were differentiated by the level of cost-sharing within the insurance plans. Manning et al. (1987) found that lower coinsurance rates (less cost-sharing) increased the utilization of health care services but that these

additional services did not lead to any significant health benefits for those in the overall sample. The results from this study are the standard by which evaluations of the effect of insurance on individuals are made. However, these findings may no longer be generalizable due to the advances in the health care field since the HIE that may have led to the improved effectiveness of the medical treatments that individuals may have access to through health insurance (McWilliams 2009).

More recent studies have relied on quasi-experimental designs to analyze the effect of health insurance on health outcomes. To avoid biases created by endogenous selection into health insurance and control for unobserved heterogeneity between the insured and uninsured, these studies have utilized natural experiments that exogenously assign insurance coverage to similar individuals. Researchers have frequently relied on the arbitrary assignment of individuals to Medicare eligibility at the age of sixty-five to explore these relationships. These analyses have established that health insurance increases the use of health care services and leads to improvements in health among the elderly as measured across a range of different outcomes. Studies have also found that Medicare increases the number of doctor visits, hospitalizations and other health care services that individuals obtain (Card, Dobkin and Maestas 2008; Decker 2005; McWilliams, Meara, Zaslavsky, and Ayanian 2003). These increases appear to be concentrated among those Medicare beneficiaries with serious health conditions and who were uninsured prior to turning 65 (McWilliams, Meara, Zaslavsky, and Ayanian 2007). Medicare also appears to have improved objective and subjective measures of individual health. Card, Dobkin and Maestas (2009) found that Medicare produced lasting reductions in the mortality rate of those admitted to the emergency room, and Lichtenburg (2002) found that Medicare leads to a

reduction in the mortality rate for those over age 65. Medicare also decreases the probability of late detection of breast cancer and reduces the chance of death among those diagnosed with breast cancer by 11 percent (Decker 2005). Here again, the benefits of health insurance on health appear to be concentrated among the previously uninsured. McWilliams et al. (2007) found that the trends in several measures of self-reported health among the uncovered improved significantly relative to those with health insurance prior to enrolling in Medicare.

While the two are not entirely comparable forms of coverage, research regarding health insurance suggests that obtaining prescription drug coverage is likely to affect utilization behavior and possibly result in positive health outcomes, particularly among those without prior coverage.

Prescription Drug Insurance and Part D

Determining the effect of prescription drug coverage is a relatively new field of inquiry but researchers have been attempting to quantify the effects of coverage on the health care utilization behavior and health outcomes of individuals prior to the establishment of the Medicare Part D program. These studies typically relied on samples of elderly individuals, possibly because the elderly take more medications and spend a higher percentage of their out-of-pocket expenditures on prescription drugs (McKercher, Taylor, Lee, Chao, and Kumar 2003). The results from these analyses provide evidence that obtaining prescription drug coverage leads to an increase in prescription use and to modest declines in out-of-pocket prescription drug expenditures (Lillard, Rogowski, and Kington 1999; Yang, Gilleskie, and Norton 2009; Shea, Terza, Stuart, and Briesacher 2007; Khan and Kaestner 2009). With respect to health, Yang, Gilleskie, and Norton (2009), found that obtaining prescription drug coverage was associated with a decline in individual mortality rates.

More recent studies have focused on estimating the effect of expanding prescription drug coverage to Medicare beneficiaries through the Part D program and have confirmed the results from earlier work. These investigations have the advantage of being able to exploit the natural experiment arising from the establishment of Part D in 2006 as a means of addressing the confounding effect of self-selection among those with coverage. Using a difference-in-difference analysis, Yin et al. (2008) and Lichtenberg and Sun (2007) estimated that Part D led to modest increases of 5.9 and 13 percent, respectively, in increased prescription drug utilization among the elderly. Using the year 2006 as an instrumental variable in a two-stage least squares regression model with a difference-in-difference estimator, Kaestner and Khan (2010) found that Part D led to much larger increases in prescription drugs utilization. They estimated that Part D resulted in a 70 percent increase in the number of prescriptions taken by an individual over the course of a year. The discrepancy in effect sizes is likely attributable to differences in how the studies determined assignment to treatment and comparison samples.[12] Drug coverage drives the marginal costs associated with obtaining prescription drugs down for covered individuals which, in all likelihood, contributes to the observed increase in prescription consumption. Presumably, the increases in utilization measured in these studies are capturing the expected response of consumers that no longer incur the full cost associated with obtaining prescription medications. Lichtenberg and Sun (2007) found that Part D led to an 18.4 percent decline in the out-of-pocket expenditures of Part D enrollees. Using a different data set and similar, but slightly modified

[12] The Lichtenberg and Sun (2007) study employs a comparison sample consisting of nonelderly individuals that were not eligible for Medicare. The Yin et al. (2008) study used a comparison sample of those that were just below the threshold for Medicare eligibility from age 60 to 63.

comparison sample, Yin et al. (2008) estimated a similar decline of 13.1 percent in out-of-pocket prescription expenditures.

While the effect of Part D on prescription utilization and out-of-pocket expenditures appears to be robust across multiple studies, researchers have only begun to analyze the implications of increased access to and utilization of prescription drugs—due to the expansion of drug coverage through Part D—for an individual's health. The most recent study by Kaestner and Khan (2010) represents the first of such attempts. Like previous studies of Part D, they exploited the natural experiment produced by the introduction of Part D in 2006. Unlike previous studies, the authors used an instrumental variable within a difference-in-difference model to estimate the effect of Part D on functional limitations and the self-reported health among the elderly. Using a pooled sample of data from the Medicare Current Beneficiary Survey, they found that prescription drug coverage through Part D has yielded no substantial improvements in the general health of Medicare beneficiaries and that the program was actually associated with an increase the number of physical limitations measured among these individuals. These results led the authors to question the value of increasing prescription drug coverage through the Part D program.

Key Questions and Hypotheses

This paper uses a quasi-experimental approach with two treatment groups to estimate the effect of Medicare Part D on four outcomes: total out-of-pocket health expenditures, non-adherence to prescription regimes, self-reported health declines, and self-reported health status. The treatment groups in this analysis will be used to estimate two different, but closely related types of treatment effects. The first effect is that of obtaining prescription drug coverage and it will be estimated using Group 1 which is composed of those individuals

that did not have prescription drug coverage prior to enrolling in Part D. The second treatment effect measures the program effect of the Part D. This effect is estimated using Group 2, a second treatment group composed of individuals with prescription drug coverage prior to enrolling in a Part D plan but who nonetheless enrolled in Part D. Because these individuals were covered before enrolling in Part D, this analysis will look for changes in the observed outcomes resulting from this transition, which is, therefore, defined here as the program effect. A more extensive explanation of the groups employed in this analysis is provided in Section IV, but this brief introduction is necessary to understand the inclusion of group-specific hypotheses in the sub-sections below.

Out-of-Pocket Expenditures

One of the primary objectives of the Part D program was to help lower the out-of-pocket medical expenditures incurred by the Medicare population. By providing prescription drug coverage, this program directly targeted the second largest out-of-pocket health expenditure for all U.S. households (see Figure 2). Prescription expenditures typically represent an even larger share of the out-of-pocket health expenditures among the elderly and disabled because they tend to be in worse general health, have more chronic health conditions, and have higher rates of disability relative to the general population and therefore, demand more prescriptions (Adams, Soumerai, Ross-Degnan 2001; Blustein 2000; Lillard et al. 1999; Rogowski and Lillard, 1997; Soumerai and Ross-Degnan 1999; Stuart and Coulson 1994; McKercher et al. 2003). Among those without coverage in the HRS in 2004, prescription expenditures accounted for 38 percent of their total out-of-pocket expenditures.

Findings from previous studies provide evidence that Part D has led to a decrease in individuals' out-of-pocket prescription expenditures (Lichtenberg and Sun 2007; Yin et al.

2009). This analysis will analyze whether this decrease is substantial enough to lower an individual's total out-of-pocket health expenditures. It is expected that the Part D will lead to substantial reductions in this amount for Group 1 for three reasons: (1) prescription drugs represented such a large fraction of total health care expenditures, (2) drug coverage may allow the individual to obtain the prescriptions that may help reduce health complications that may have otherwise been costly to treat and may have required additional out-of-pocket expenditures and (3) drug coverage lowers the cost of prescription therapy relative to other forms of health care that may require greater out-of-pocket expenditures to obtain.

Group 1 - Hypothesis 1a: Obtaining prescription drug coverage lowers the total out-of-pocket medical expenditures of households.

It is also expected that individuals in Group 2 will have lower total out-of-pocket medical expenditures. While individuals in Group 2 had drug coverage prior to enrolling in Part D, the results from a regression analysis estimating the likelihood that an individual with coverage substituted their existing plan for a Part D plan suggest that this transition may result in lower out-of-pocket expenditures, including the cost of prescription plan premiums. The regression results displayed in column 2 of Table 3 indicate that those with plans covering only "some" of their prescription drug costs in 2004 were more likely to enroll in a Part D plan than were those with a plan that covered "all" or "most" of their prescription costs. These results indicate that having less comprehensive coverage increased the probability that an individual enrolled in Part D by 22 percentage points (Table 3). While it is impossible to determine from the data, these results suggest that those with less coverage may have left their existing plans because they were less comprehensive than those available through Part D. This additional coverage could lead to less out-of-pocket expenditures.

Group 2 - Hypothesis 1b: Enrollment in the Part D program by those with prior coverage will lower their total out-of-pocket expenditures.

It is possible, however, that the income effect generated from the decrease in prescription costs may attenuate or offset these declines once health expenditures are aggregated for each individual. Health care is a normal good which means that the income elasticity of demand for health care is positive. Therefore, it is possible that the observed decrease in individual prescription drug expenditures may increase individual consumption of other health services. This behavior would serve to offset the decline in out-of-pocket prescription expenditures to the individual's total out-of-pocket expenditures. While this reaction may attenuate the effect of Part D on total out-of-pocket health expenditures, I consider this reaction unlikely because prescription drug costs represents such a large fraction of total out-of-pocket expenditures, and the estimated magnitude of the income elasticity of the demand for health is relatively small, falling between the range of 0 and .2 (Ringel, Hosek, Vollaard, and Mahnovski 2000).

Adherence

Next, I expect that access to prescription drug coverage will increase adherence to prescription drug regimes. As Safran et al. (2005) reported, those without coverage were more likely to have avoided or reduced their prescription drug use due to costs. Data from the Health and Retirement Survey indicate adherence was difficult for a substantial fraction of members from both treatment groups in this analysis (Group 1: 15 percent; Group 2: 11 percent). Given that researchers have consistently demonstrated a reduction in the out-of-pocket prescription drug expenditures among those who enrolled in Part D without prior

coverage, I expect to find that fewer individuals report having sacrificed adherence to their prescription drug regime to avoid the costs associated with this form of therapy.

> *Group 1 - Hypothesis 2a*: Enrollment in a prescription drug coverage plan decreases the rate at which of individual reported that costs led them to take less medication than was prescribed to them.
>
> *Group 2 - Hypothesis 2b*: Enrollment in Part D decreases the rate at which of individual reported that costs led them to take less medication than was prescribed to them.

The results from the third and fourth column of Table 3 indicate that higher prescription expenditures are associated with higher rates of non-adherence for individuals in Groups 1 and 2. The results suggest that a one percent increase in out-of-pocket prescription expenditures increases the likelihood that an individual reports taking less prescriptions than have been prescribed to them by 2.4 and 3.1 percentage points for Group 1 and Group 2, respectively. If Part D is successful in reducing these costs, it is possible that the cost-related rates of non-adherence will decline.

Health Declines

The second part of this analysis examines health outcomes. The Kaestner and Khan (2010) study marks the first attempt by researchers to estimate the actual effect of Medicare Part D on individual health. Using data from the Medicare Current Beneficiary Survey, the authors concluded that Part D is associated with "worsening functional health" and does not lead to significant improvements in general health. Their results would suggest that there is little to be gained in terms of health from increasing prescription drug coverage. However, there are critical concerns regarding the suitability of some of the outcomes they used to

estimate the relationships in their data and there were problems associated with the statistical power of their analysis that precluded the estimation of smaller health effects that call into question strength of their claims.

The authors employed multiple health outcome measures from the activities of daily living (ADL) and instrumental activities of daily living (IADL) indices. The ADL and IADL are composite scores indicating whether the individual has difficulty or limitations on such things as eating, dressing, bathing, walking, using a phone, going shopping, managing money, and doing housework. There are multiple reasons to question appropriateness of this outcome to measure the effect of Part D on health. First, the Medicare population consists entirely of elderly and disabled individuals, who, by the nature of their advanced age and general health condition, likely have intractable physical limitations. Even if prescription drugs are able to improve mobility, there is a limit to extent to which these individuals would regain their functional capacity. Second, these indices measure functionality through ease of task completion, but physical limitations among the elderly and disabled are not always symptoms of ailments treatable through prescription drugs. This is especially true when one considers the components of the ADL/IADL indices used in their analysis. Aside from those with psychiatric impairments, prescription drugs may not significantly improve an individual's ability to manage their money, go shopping, or use a phone for those with physical limitations. Furthermore, the drugs taken by most of those in Part D have little or nothing to do with functionality. According to data from the Centers for Medicare and Medicaid Services (CMMS), of the ten drugs taken by most frequently by Part D enrollees only one (Advair) may improve the functional capacity of the elderly.[13] The prescriptions

[13] Advair is taken to help with respiratory issues.

most frequently filled are for drugs intended to reduce blood pressure, regulate cholesterol, and to treat diabetes (Hargrave, Hoadley, Cubanski, and Neuman 2009). These drugs are intended to reduce the risk of a negative health shock rather than improve mobility or physical limitations. Therefore, Part D may not have a significant or a direct affect on either the ADL or IADL. On the contrary, by regulating health conditions that may otherwise result in rapid health declines that lead to death, access to prescription drugs through drug coverage may actually increase the average number of disabilities found among Medicare beneficiaries as sick individuals are able to live longer. When Yang, Gilleskie, and Norton (2009) coupled their findings regarding the negative effect of prescription drug coverage on individual mortality rates with the positive effect of prescription drug coverage on the number of IADLs and ADLs, they concluded that the survival of sick individuals resulted in an increase in the average number of functional limitations found among the elderly. This would indicate that the positive effect of Part D on the IADLs and ADLs indices measured by Kaestner and Khan (2010) was actually capturing the same indirect effect of Part D prescription drug coverage on these outcomes through longevity. Because most of the prescriptions taken by these individuals are intended to reduce the risk of a negative health shock and ameliorate the symptoms resulting from chronic conditions, rather than improving or eliminating the underlying condition, the more relevant question appears to be whether obtaining prescription drug coverage has helped stabilize the rate of individual health declines.

> *Group 1 - Hypothesis 3a*: Enrollment in prescription drug coverage will help reduce the rate at which individuals report a health decline.
>
> *Group 2 - Hypothesis 3b*: Enrollment in Part D will help reduce the rate at which individuals report a health decline.

Self-Reported Health Status

This analysis will also re-examine the relationship between Part D and general health outcome analyzed by Kaestner and Khan (2010). They operationalized general health by collapsing a five scale self-reported health status (excellent/very good/good/fair/poor) into a dichotomous measure indicating whether the individual was in good or better health. The authors concluded that Part D was not associated with any large improvements in general health; however, it is worth revisiting this analysis due to the lack of statistical power associated with their estimation.

The lack of statistical power prevented Kaestner and Khan (2010) from being able to reliably detect effect sizes within 33 percent of a standard deviation of the mean. This is an important limitation because it is likely that any health effect of prescription drug coverage would likely to be small given, again, the advanced age and physical condition of the Medicare population and the fact that the prescriptions taken most frequently by Part D enrollees are aimed at regulating symptoms and health shocks associated with chronic health conditions. More importantly, the decline in the general health of seniors over time likely places a low upper bound the positive effect size of prescription drug coverage. It is likely that, for the elderly, the most a prescription drug can do is help mitigate the rate of this natural and inevitable decline. These factors may place a low upper bound on the positive effect of Part D on general health and diminish the likelihood of a substantial improvement in health. Thus, the analysis run by Kaestner and Khan (2010) would not have captured what is likely a small effect size.

Their use of a two-stage instrumental variable research design may have contributed to the lack of statistical power in their analysis. This method can lead to overly large standard

errors and inconsistent estimates when the correlation between the instrument and the instrumented variable is low, increasing the likelihood of making a Type II error (Bound, Jaeger, and Baker 1995). For this reason, this analysis will attempt to estimate the effect of Part D on general health more precisely and efficiently using a different research design that does not rely on instrumentation.

I will re-examine whether Part D had an effect on general health. However, in light of the general decline in the percent of those reporting to be in good or better health over time (See Figure 3: "Percent Reporting to be in Good Health"), the results of this analysis will be interpreted as the effect of Part D on individuals' transition from "good" to "poor" health. That is, it is more likely that Part D reduced the rate at which individuals transitioned from good health to bad health over time rather than moving individuals from bad health to good health. Under this interpretation, the effect of Part D is not in improving health but in preserving it.

> *Group 1* - *Hypothesis 4a*: Enrollment in prescription drug coverage will reduce the rate at which individuals transition from good health to poor health.
>
> *Group 2* - *Hypothesis 4b*: Enrollment in Part D will reduce the rate at which individuals transition from good health to poor health.

In sum, this analysis employs utilization outcomes that are important for determining whether Part D has been successful in two important goals of the program: (1) reducing total health expenditures and (2) improving adherence to prescribed treatments by helping eliminate the barrier imposed by prescription drug costs. The analysis will also attempt to

estimate the health effect of Part D using outcomes that are amenable to prescription drug therapy and a research design that does not require a valid and strong instrumental variable.

Methods and Data

The data used in this study comes from the Health and Retirement Study (HRS), a nationally representative sample of elderly U.S. residents born in 1947 or earlier. The longitudinal survey design of the HRS allows researchers to follow older cohorts as they make the transition from work into retirement. Every two years this survey compiles information on the demographics, health, social, and economic factors from the more than 20,000 elderly individuals it follows. This analysis will utilize the rich demographic and health-related variables in the HRS as well as information regarding Part D and prescription drug coverage. This analysis relies on data from the 2004 to 2008 waves of this survey.

This analysis relies on an exogenous source of variation to implement a counterfactual approach to estimate the effect of prescription drug coverage through the Medicare Part D program on health-related outcomes. The exogenous factor in this analysis is the date in which Part D prescription drug coverage became available to those eligible for Medicare. The natural experiment afforded by the introduction of this program in 2006 allows for a difference-in-difference research design to analyze the effect of Part D on the outcomes outlined above. This is the method most frequently employed by researchers to analyze the effect of Part D on health-related outcomes (Yin et al. 2008; Lichtenberg and Sun 2007; Kaestner and Khan 2010).

Difference-in-difference (DID) estimation is useful for making comparisons across groups in instances where at least one of those groups in question was exposed to an intervention or treatment (treatment group) and at least one of those groups was not (control

group). This method requires that outcomes of interest and any covariates be observed for the exposed and unexposed groups in time periods both prior to (pre-treatment) and following the introduction of the treatment (post-treatment). Estimation of the treatment effect using DID is accomplished by calculating the difference in the pre-treatment and post-treatment change in the outcome of interest between the treatment and control groups over time. Interpreting any difference as a causal treatment effect requires the assumption that in the absence of the treatment, any differences in the outcomes observed between the two groups would be the same over time and that no other group-specific changes or interventions have occurred that might also account for the change.

Unlike many quasi-experimental designs, DID estimation does not require the expectation of pre-treatment equivalence between treatment and control groups. In fact, DID models allow for systematic differences in the pre-treatment mean of the outcome for treatment and control groups but require that those observed differences are the consistent over time and would otherwise remain in the absence of treatment. Propensity scores require that all the variables necessary for selection to be known, measured, and modeled (Cook, Shadish, and Wong 2008; Diaz and Handa 2006). Many of the variables measured in the HRS may be correlated with selection into the Part D program, but it is difficult to be certain that the available data is sufficient to model the selection equation accurately. The use of regression discontinuity is also problematic due to the survey design of the HRS and the lack of information available about the specific dates regarding drug coverage and enrollment in Part D. No continuous measure is available that would easily accommodate this type of analysis. The DID estimator represents the most effective means by which to estimate the treatment effect of Part D while requiring the fewest number of identifying assumptions.

The key identifying assumption of this method is that the mean values of the outcome variable for each group share a common trend prior to the introduction of the treatment. The validity of this assumption can be tested by analyzing the trends in the outcome over time between the two groups. A second important assumption is that the control group is unaffected by the treatment, in this case Medicare Part D. The evidence substantiating the plausibility of this assumption is less direct and will require an evaluation of the available evidence regarding the impact of Part D on those with prescription drug coverage from sources outside of Medicare. There is substantial heterogeneity in the types of coverage offered by plans within the Part D program so any effect measured is the average effect across each of these different plans.

After verification of the necessary assumptions, the DID estimators are included in ordinary least squares regression models. These models are used to estimate two separate but related treatment effects: (1) the effect of prescription drug insurance in general and the (2) effect of Part D specifically on the health and health-related outcomes among a sample of Medicare-eligible individuals. Estimating each treatment effect thus requires the construction of the two unique treatment groups and the control group noted above. The next section discusses the construction of these groups in more detail.

Pre-Treatment and Post-Treatment

On January 1, 2006, individuals enrolled in Medicare could obtain prescription drug coverage through the Part D program. The timing of this policy change represents an exogenous shock in the availability of prescription drug coverage through Medicare and is used to define the pre-treatment and post-treatment time periods. In this analysis, the pre-

treatment period is the 2004 wave of the Health and Retirement Survey (HRS) and the post-treatment time period is the 2008 wave.

While the 2006 wave of the HRS contains data relevant to this analysis, this wave is excluded from this analysis for two reasons. First, the structure of the HRS survey does not allow for a clear distinction between pre- and post-treatment data in the 2006 wave. Because the HRS is administered every two years, respondents are frequently asked to include the inter-wave years when considering their responses to the survey questions. For example, in each wave of the HRS, respondents are asked whether they have experienced any health declines since their interview in the previous wave. Therefore, in the 2006 wave, respondents include any such decline that occurred between their interview in 2004 and their interview in 2006. The inability to distinguish exactly when these declines occurred poses problems for determining the effect of Part D coverage on health declines in the years covered in the 2006 wave because this program could not begin to affect this outcome until individuals were actually able to enroll in the program in 2006. The aggregation of responses across inter-wave years may attenuate any estimated effect of Part D in the 2006 wave because individuals would have been exposed to the treatment in 2006, but the data from this wave would also include, for some respondents, changes in overall health and health expenditures from 2004 and 2005. Therefore, the 2008 wave of data will be considered as the only post-treatment data point. This specification avoids the complications associated with the combination of pre-treatment and post-treatment outcomes in the 2006 wave and includes data collected exclusively in the post-treatment time period, between 2007 and 2008.

Second, it is impossible to determine how long individuals have been covered by Part D in the 2006 wave of the data. The effect of Part D is unlikely to be immediate due to the

nature of pharmaceutical therapy, and utilization changes in the outcomes of interest may not respond immediately to drug coverage. For example, health does not always respond immediately to pharmaceutical therapy as the benefits frequently accrue with continued use over the long-term. Therefore, the duration of drug coverage through Part D may moderate the effect that coverage and prescriptions drugs obtained through this program have on an individual's health outcomes. Without data measuring the duration of ones Part D coverage, it is difficult to isolate the total effect of drug coverage in the 2006 wave. In contrast, in the 2008 wave individuals have been exposed to the treatment for two years or more, plenty of time for the effects of Part D prescription drug coverage to manifest themselves.[14]

Treatment and Control Groups

There are two treatment groups and one control group in this study, all of which are mutually exclusive. The first treatment group (Group 1) will be used to analyze the effect of prescription drug insurance on the health-related outcomes. This group consists of those Medicare-eligible individuals who reported having no prescription drug coverage in the 2004 wave of the HRS, prior to obtaining drug coverage through a Part D plan in 2006. This group includes only those individuals who maintained their drug coverage in a Part D plan through 2008. The treatment for this group is defined as the effect of prescription drug coverage. This interpretation is based on the fact that individuals in this group reported having no prescription drug coverage just prior to the establishment of Part D and enrolled in Part D when it became available; therefore, changes in the health-related outcomes relative to the control group may be interpreted as the result of having obtained prescription drug coverage from a Part D plan.

[14] A secondary analysis that includes the 2006 wave will also be conducted however, it is expected that the inclusion of this data will attenuate the estimates of the treatment effect in the DID models.

The second treatment group (Group 2) includes those Medicare beneficiaries who were covered by a prescription drug plan between 2002 and 2004, prior to enrolling in a Part D plan in 2006. Individuals in Group 2 changed their preexisting prescription drug coverage to a Part D plan when it became available in 2006. A separate specification of the treatment effect for Group 2 is necessary because the nature of the intervention is distinct for each treatment group. These individuals in Group 2 already had drug coverage so the treatment effect for this group is that of the Part D itself rather than other types of drug coverage. The DID estimates for this group will measure the effect of transitioning out of existing coverage into a Part D plan sponsored by Medicare. Any positive (negative) effects found may be attributable to better (or worse) coverage under a Part D plan rather than to prescription drug coverage in general.

The control group (Control) is composed of Medicare-eligible individuals who had prescription drug coverage from an alternative source prior to the establishment of Part D and maintained that coverage through 2008. Individuals in the Control group are covered by Medicare but chose not to change their coverage to Part D when it became available. These individuals reported in the HRS survey that they did not sign up for Part D because they already had prescription drug coverage from another source. In order for this group to serve as an adequate counterfactual, there must be common trends in the mean values for the outcomes analyzed for this group and the treatment groups. It is also necessary that these individuals not be otherwise affected by the establishment of Part D. The plausibility of these assumptions will be explored in the next section.[15]

[15] A second possible control group could be assembled from those individuals that reported having no coverage in both the pre-treatment and post-treatment periods. Because these individuals have not reported prescription drug coverage at any point during the reference period considered in this analysis, it is unlikely that these individuals have been affected by the Part D program. However, this group of individuals represents a small

To be included in either treatment group the individual had to have obtained their Part D coverage in 2006 and maintained it through 2008. Treated individuals may have changed their plan since enrolling in the Part D program in 2006, but as long their plan remains within the Part D program, they are included in their respective treatment group. The control group was limited to those individuals that reported to have had prescription drug coverage from a source external to Medicare in 2004, 2006 as well as in 2008. These restrictions are necessary to ensure that individuals in both treatment groups were receiving the treatment for the entire post-treatment period and that members of the control group did not receive coverage from Part D during the post-treatment period. Also, all groups are limited to those individuals who reported taking prescription medications regularly in all three of the 2004, 2006 and 2008 waves of the HRS.[16] This step was necessary because the HRS only asks about the drug coverage of those who reported taking prescriptions regularly. This restriction will likely limit the entire estimation sample to those who have long-term negative health conditions. Limiting the sample to those who have been taking prescriptions regularly over time may bias the likelihood of finding a positive treatment effect because the estimation sample likely consists of individuals with persistent health complications that may be in the most need of prescription therapy and drug coverage.

Identifying Assumptions of the Difference-in-Difference Research Design

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fraction of the total sample. There are 104 individuals in this group accounting for 2.5 percent of the total sample and 5 percent of the total sample that did not enroll in Medicare Part D. Allowing this group to serve as the counterfactual in this analysis would drive down the statistical power of this estimation and produce efficient estimates.

[16] The HRS does not provide a definition for "regularly." The survey simply asks the respondent to answer "yes" or "no" to the question: "Do you take prescription medications regularly?" Those that answered in the affirmative were included in the analysis.

Difference-in-difference estimation does not require an assumption of equivalence on the observed covariates between the treatment and control groups. It does, however, require the assumption that the observed differences in time trends of the outcome variables between the treatment and control groups remain consistent in the absence of treatment. The standard method to test the plausibility of this assumption compares the pretreatment time trends of outcome variables for the treatment and control groups. Stability in the differences in the pre-treatment time trends is considered evidence that supports the validity of the identifying assumption. Figure 3 displays the pretreatment trends for those assigned to the treatment and control groups for each outcome used in this analysis. The data points in the figures reflect the group-specific mean for a particular outcome in a given year from 2000 to 2008.[17]

In general, the differences in the group-specific pretreatment means of the utilization variables appear to be stable for Group 1 and the Control group. The average amount out-of-pocket expenditures appear to increase for both groups in each wave between 2000 and 2004 and the difference in growth rate appears stable over the pretreatment period. While the upward trend in the rate at which individuals report taking less medication than what was prescribed to them is steeper for Group 1, the difference in the rate of increase appears constant between the two groups. There is also strong support for the validity of the identifying assumption for causal claims within the difference-in-difference method of estimation among the health outcomes analyzed in this study. The time trend for the mean estimates of the percent of those reporting to be in good health and those reporting a health decline are stable in the pretreatment period.

[17] Data from the year 2006 are excluded from these figures. The inclusion of 2006 data does not change the interpretation of the results.

The results of the comparison for the pretreatment trends between Group 2 and the Control group, however, are mixed. The group-specific time trends for the out-of-expenditures and the percent of individuals reporting to be in good health are similar for each group. The direction of the trends are consistent and, more importantly, the difference between the estimates of the mean appear stable over time. In contrast, the pretreatment trends between the two groups for the average percent of individuals in each group who report taking less medication than they were prescribed due to cost and for those who report health declines do not appear to be stable. The divergence in the pretreatment trends of these outcomes violates the key identifying assumption of the difference-in-difference methodology; therefore, these outcomes will be excluded from the discussion of the results of the effect of Part D on Group 2.

A regression analysis of the pre-2006 data reveals that there are some significant differences in the pre-treatment trends for the observed outcomes between the treatment and control groups. To capture the changes in the trends between the groups, interaction terms were included indicating the year and treatment group assignment. The regressions were run separately for Group 1 and the Control and Group 2 and the Control. The results from these regressions are provided in Table 4. Given the rapid rise in medical expenditures, particularly for prescription drugs (see Figure 1); it is unsurprising that the out-of-pocket expenditures increased at a more rapid rate among those without drug coverage prior to enrolling Part D (Group 1) than for the Control group in each year analyzed. There were also significant differences between the pre-treatment trends in the rate of non-compliance between Group 1 and the Control group in 2004. That out-of-pocket expenditures and the rates of those taking fewer prescriptions due to costs were increasing for these groups is not surprising given that

these individuals bore full cost of the rising costs of prescription therapy. In fact, this was part of the logic behind providing drug coverage through Medicare. While these differences are important to note, they should not invalidate the findings for these outcomes because there was no variation in direction of the trends (they were constantly increasing), and it is unlikely that any estimated effect of Part D in changing the direction of these trends would be confounded by a regression to the mean as prescription drug prices have not appeared to decline over time. That is, these differences would be expected to continue to trend upward in the absence of Part D and rising prescription expenditures. Finally, there were no significant differences in the changes in the pre-treatment trend lines for Group 1 and Control over time for either of the health outcomes. A Wald test confirmed that these coefficients were not jointly significant at the .05 level.

The regressions including Group 2 and the Control indicate that there were no significant differences between the pre-treatment trends in the out-of-pocket expenditures for these groups. This is, perhaps, unsurprising given that neither of these groups bore the full cost of their prescription drugs. However, there were significant reductions over time between the pre-treatment trend lines in the Group 2 and the Control for rate at which individuals reported taking less prescription drugs due to costs and for rate at which individuals reported a decline in their health status. This finding suggests that attributing changes in these outcomes to Part D may not be possible because the continued convergence of the trends may be mistakenly interpreted as the effect of Medicare Part D on these outcomes for this group. The was also a significant difference in the pre-treatment trend in the rate of those reporting to be in good health in Group 2 relative to the Control. Given the small difference in the trend lines for this outcome between these two groups, it is possible

that a small effect estimated for Part D could represent a regression to the mean rather than a treatment effect. For this reason the discussion of the results will focus, primarily, on those for Group 1.

A second important assumption is that Medicare Part D had no affect on the control group. The control group is composed of those Medicare-eligible individuals that did not enroll in Part D in 2006 or 2008 because, as they reported, they "already have good prescription drug coverage." The HRS does not specify the source of this coverage, but the source is either an employer or government program other than Medicare. Because Part D is not mandatory, its availability should not have a direct affect on the health-related outcomes of individuals who do not enroll. However, it is possible that Part D may have an indirect effect on alternative sources of coverage by increasing demand in the prescription drug market, thereby increasing prescription drug prices in addition to the issues associated with "credibility" outlined in the previous section. An increase in the price of prescription drugs may lead those offering prescription drug plans to reduce coverage or increase the premium or deductible that plan participants must pay. However, the available evidence suggests that Part D has had no such effect. In fact, Duggan and Morton (2011) found that the program structure Part D actually led to a decrease in the price of brand name pharmaceuticals. A decrease in the price of pharmaceuticals could attenuate any positive relationship between the health-related outcomes in this study and Part D to the extent that this price decline increases the likelihood that members of the control group have newfound access to these drugs and that these drugs are effective in addressing their health problems and to the extent that these declines reduced the out-of-pocket expenditures of the Control group.

However, it is important to point out a change that resulted from Part D that may contaminate the control group. The MMA established that the coverage that a Medicare beneficiary with coverage outside of the Part D program be "creditable", that is, it must pay at least much as Medicare's standard prescription drug coverage of the participant's prescription drug costs, on average.[18] Neuman et al. (2007) estimate that, at most, 8 percent of seniors that had drug coverage prior to this new requirement did not have creditable coverage. It is impossible to identify those with non-credible coverage in the HRS so individuals in the control group may have had their coverage change as a result of Part D. Going from a non-credible to a credible plan may attenuate the treatment effect in this estimation, particularly for the cost-related outcomes in this analysis as this requirement establishes a lower bound on benefit levels for existing plans. Finally, it is also possible that the prescription plans among the control group became less generous or comprehensive between 2004 and 2008. If the coverage of the control group became worse relative to the coverage provided by Part D, then the estimates in this study will be biased upward.

The Model

$$Y_{it} = \alpha + \beta T_i + \lambda P_{it} + \delta(T_i * P_{it}) + \gamma X_{it} + \varepsilon_{it} \qquad (1)$$

The DID estimation strategy shown in Equation 1 models the outcomes using pooled OLS regression where T_i is a dummy variable indicating whether the individual is assigned to the treatment (T_i =1) or control (T_i = 0), P_{it} is dummy variable indicating whether the time period is pre-treatment, prior to the establishment of Part D, (P_{it} = 0) or post-treatment, after the establishment of Part D, (P_{it} = 0), X_{it} is a vector of control variables outlined below and

[18] Creditable coverage must provide coverage for brand name and generic drugs, reasonable access to retailers, pay at least 60 percent of participants' prescription drug expenses. It must also have either a maximum annual benefit payable by the plan of at least $25,000 or a deductible of no more than $250 per year

listed in Table 1, and ε_{it} is a random error component with a mean of zero ($E[\varepsilon_{it}] = 0$). The interaction term ($T_i * P_{it}$) equals one if $T_i = 1$ (treatment group) and $P_{it} = 1$ (post-Part D). The coefficient δ is the difference-in-difference parameter, measuring the effect of Part D on the outcome Y_{it} in question. Equation (1) is estimated using robust standard errors to correct for the serial correlation that likely exist between the error terms of the multiple observations of individuals in the pooled sample and heteroscedastic errors in the linear probability models.

Variables

The HRS has detailed measures on health and health-care utilization including self-reported health, self-reported health declines, activities of daily living limitations (ADL), instrumental activities of daily living limitations (IADL), out-of-pocket health expenditures, prescription drugs, and various measures on the number and type of health care services received. These variables comprise the outcome measures tested in this analysis.

Utilization-Related Outcome Variables

Out-of-Pocket Expenditures

This outcome variable is a continuous measure of the out-of-pocket medical expenditures incurred by the individual over the past two-years (between survey waves). This measure is the sum of eight different components of health care expenditures paid by the individual: 1) hospital costs, 2) nursing home costs, 3) doctor visits costs, 4) dentists costs, 5) outpatient surgery costs, 6) prescription drug costs, 7) home health care and 8) special facilities costs. As a result, only those individuals with positive out-of-pocket medical expenditures are included in this analysis. This is not a significant restriction because Part D was implemented, in part, to lower the out-of-pocket prescription expenditures of the elderly. The program would not be expected to benefit those who have no out-of-pocket health

expenditures. This effect of Part D on the outcome was tested at a number of different levels to minimize the likelihood that outlying observations were skewing the effect size (0<$200,000; 0<100,000; 0<50,000; 0<$25,000; 0<$10,000; 0<$5,000). The results from the full sample are reported and discussed after the consistency of the relationship at each of the expenditure levels is confirmed.[19]

Take Less Medication Due to Costs

This outcome variable is a dichotomous variable coded as 1 if the respondent reported taking less medication than was prescribed to them due to cost and 0 otherwise. This measure will be used to test whether Part D decreased the likelihood that individuals reported having failed to adhere to their prescribed prescription treatment. In other words, it will be used to test whether Part D increased the likelihood that individuals complied with their prescription therapy.

Health-Related Outcome Variables

Deterioration of Self-Reported Health Status

This dichotomous outcome variable indicates whether the health status of the individual has declined since the last interview wave. This variable is coded 1 if the individual reported that their health status had gotten worse over the previous two years and coded 0 if the individual reported that their health had improved or remained same over the past two years. This variable will also be used to test whether prescription drug coverage through Part D helped moderate health declines among the elderly.

[19] These additional sensitivity checks were necessary because there were a number of outlying observations. A log-transformation was not performed because it is more intuitive to think about the difference-in-difference in terms of actual dollar amounts rather than the difference-in-difference in terms of percent changes. Additionally, the interpretation of an interaction term in non-linear models is complex but statistical packages are widely available to accommodate this type of estimation (Ali and Norton 2003; Karaca-Mandic and Norton Forthcoming).

Self-Reported Health Status – Good Health

This outcome measure is a dichotomous variable indicating whether the individual is in good or better health. The variable is coded 1 if they reported themselves to be in "good," "very good," or "excellent," health and 0 if the individual reported being in "fair" or "poor" health. Collapsing the categories into a dichotomized variable avoids placing undue importance on what may be arbitrary variation between say, "very good" and "excellent" response categories. This variable will be used to test whether individuals are more likely to report being in good health following the availability of prescription drug coverage through Part D.

Control Variables

Demographic and socio-economic variables are also included to control for the effect that of age, race, marital status, education, total wealth (log-transformed), of the individuals on their health care utilization and health outcomes.[20] Age and the log-transformed estimate of household wealth are entered into the regression models as continuous measures. Dichotomous variables are entered into the regression models that indicate whether the individual is African-American, male, married and whether the respondent has a high school diploma, whether have some college education, or a college degree or higher. Control variables that measure determinants of individual health are also included in the model. Using definitions from the Center for Disease Control, two dichotomous variables were constructed indicating whether an individual is over-weight and underweight are constructed based on their body mass index (BMI) measure. Individuals with a BMI of 25 or over were

[20] Household income was not included in the model due to concerns related to simultaneity bias. Because the health-related outcomes can affect income, the inclusion of this variable would bias the coefficients estimated for this variable as well as those correlated with income. For this reason, income is not included in any of the models estimated.

coded as 1 for the variable indicating whether an individual is over-weight and 0 otherwise. Those with a BMI less than 18.5 were assigned a value of 1 for the variable indicating whether an individual is under-weight and 0 otherwise. The respondents assigned to the base case for this analysis are those with "normal" BMI measures (18.5 to 24.9). Another dichotomous measure was included indicating whether an individual currently smokes cigarettes. Finally, a lagged measure of physical mobility was included to help control for the effect of physical limitations on the outcome analyzed. The mobility variable is the sum of several dichotomous measures indicating whether an individual has difficulty walking one block, walking several blocks, walking across the room, and climbing one flight of stairs. This measure is a derivation of the ADL/IADL index that focuses on mobility and intended to be a proxy for physical condition. The ADL/IADL indices were not used because certain components of these measures were less relevant to physical condition such as the ability of the individual to use a telephone, microwave, or map. Larger values of the mobility index represent greater physical limitation. This measure is lagged to avoid the possibility of simultaneity bias where, for instance, a health decline leads to a reduction in physical and functional capacity.

Descriptive Statistics

Table 1 presents summary statistics for the dependent and independent variables for the two treatment groups and the control group used in this analysis. The descriptive statistics in the table highlight important differences between the groups. Relative to the Control group, those in Groups 1 and 2 assigned to treatment have higher out-of-pocket medical expenditures and are less healthy according to each measure of individual health included in this study. The treatment groups are also much more likely to have reported to have taken

less medication than was proscribed to them due to the costs associated with prescription drug treatment. Individuals assigned to Group 1 and Group 2 are less likely to be female, are less educated, less mobile and are less likely to be married.[21] While the systematic differences between the treatment and control groups are important, as noted above group equivalence is not a necessary assumption for estimating an unbiased treatment effect when using a difference-in-difference model because these group fixed-effects are "differenced out" in the estimation procedure.

A linear probability model was used to help clarify the reasons why individuals enrolled in the Part D program in 2006. The estimates reported in Table 3 are obtained from regressing a dichotomous outcome indicating whether the individual enrolled in Part D in 2006 on pre-treatment covariate measures from the 2004 wave of the HRS that are thought to be correlated with enrollment in the program. The coefficients of interest for full sample of Part D enrollees (from both Group 1 and Group 2) are on the variable indicating whether the individual was taking prescriptions regularly. For Group 2 the coefficient of interest was on the variable indicating whether their existing coverage paid only part, rather than most or all of the individual's prescription costs. According to the estimates for the full sample in the first column of Table 3, individuals who reported taking prescription medications regularly were more likely to enroll in Part D by 15 percentage points than those who did not take medications regularly. This finding suggests that there was considerable need and unmet demand for drug coverage among those taking prescriptions most frequently. It is unclear, however, whether it was a lack of access, the high cost of coverage, or some other impediment that prevented these individuals from obtaining drug coverage prior to Part D. The results for Group 2 in the second column suggest that many left their existing coverage

[21] These differences are statistically significant at the .05 level.

due to under-coverage. Individuals who reported that their coverage covered only part of their prescription costs were more likely to exchange their existing coverage for Part D by 22 percentage points. The results from both of these regressions suggest that the plans in Part D were attractive to those looking to obtain coverage as well as those looking to expand existing coverage. The important question addressed in the next section is whether by filling this demand for coverage, Part D has had any changes in health care utilization or health outcomes.

Results

In this section I present evidence that Medicare Part D has led to large and significant reductions in both household health expenditures and the percent of Medicare beneficiaries that reported taking less medications than were prescribed to them due to costs. I also show that Part D has led to moderate reductions in the number of Medicare beneficiaries reporting health declines and even led to slight improvements in self-reported health. Panels A and B in Table 5 report, respectively, the regression results for Group 1 and Group 2 from the difference-in-difference estimation. The coefficient of interest in each is that of the interaction term Treatment*Post which is interpreted as the effect of Part D on the outcome in question. The results from Panel A suggest that Part D had the expected affect on each of the health care utilization and health outcomes analyzed for Group 1. The difference-in-difference estimates for the effect of Part D on out-of-pocket medical expenditures indicate that drug coverage helped reduce out-of-pocket medical expenditures, decreased non-adherence due to prescription costs and led to positive health outcomes, and the treatment effects were smaller for those in Group 2.

Difference-in-Difference Results: Health Care Utilization

The results depicted in the first and second column of Table 5, demonstrate that Part D had a negative and statistically significant effect on the total out-of-pocket health expenditures for both treatment groups. The coefficient on the DID estimator (Treatment*Post) in column 1 of Panel in Table 5 indicate that Part D led to a $3,105 reduction, on average, in the out-of-pocket expenditures among Group 1. The first column in Panel B indicates that Part D led to $1,145 reduction in the out-of-pocket expenditures of those in Group 2. The estimates of the treatment effect are statistically significant for both groups. The relationship between Part D and non-adherence to prescribed drug treatment also took the expected direction. These results are reflected in second column of each panel. The estimates on the DID estimator indicate that Part D resulted in 7.9 percentage point drop in the rate of cost-related non-adherence for Group 1. This decline represented a statistically significant change. The change for Group 2 represented a more modest decline of 1.4 although this estimate was not statistically significant. Over the same period the out-of-pocket expenditures of the control group increased only slightly but by a non-significant amount. Non-adherence also increased by a modest 1.2 percentage points from the pre- and post-treatment period for the control group. These increases reflect a continuation of the pre-treatment trends of both outcomes for the Control group and imply that Part D had no effect on this group and that there were no other period effects that may be distorting the results. The stability of these trends provides more evidence in support of the claim for the treatment effects measured for the treatment groups.

Difference-in-Difference Results: Health Outcomes

The right-hand columns of Table 5 present the results from the two key measures of health analyzed in this study: (1) “Did the individual report a health decline in the previous

two years?" and (2) "Did the individual report to be in good health?" based on self-reported data. According to the difference-in-difference estimate from Group 1 in column 3 of Table 5, enrollment in Part D is associated with a statistically significant decrease in the likelihood that an individual reports a health decline by 4.3 percentage points. Column 4 displays the result from the regression estimating the effect of Part D on self-reported health for Group 1. The coefficient on the DID estimator indicates that Part D has led to a significant 6.5 percentage point increase in the likelihood that an individual in Group 1 reported to be in good health. The DID estimators in each of the models for Group 2 were smaller in magnitude and not statistically significant.

The regression results indicate that, after controlling for the covariates in the model, the Control group was only slightly less likely to report a health decline, but this decline was not significantly different than zero. The rate at which individuals in the Control group reported being in good health did decline by a statistically significant 4.1 percentage points in the model for Group 1 (a 3.8 percentage point decline in the model for Group 2). This decrease likely represents the natural rate in the decline of health as the graph plotting the mean estimates of the "Percent Reporting to be in Good Health" appears to continue its downward trajectory. This is the expected result from the aging process of sample of elderly individuals.

Discussion

This analysis has shown that Part D has led to important and substantial changes in health care utilization and modest positive effects on individual health outcomes. The effect of prescription drug coverage estimated for Group 1 is evident for each outcome in this analysis. The treatment effect of the Part D program itself (Group 2), however, is limited to a

reduction in out-of-pocket expenditures which is intuitive as many in this group were less likely to have had comprehensive coverage prior to Part D (see Table 3). The findings imply that those in Group 2 might have already realized the health benefits from prescription drug use in their previous plan and continued to do so within Part D with no discernable change.

The findings from this analysis on out-of-pocket expenditures comport with the available literature regarding the effect of Part D on prescription expenditures. This study found that Part D led to a decline in the overall health expenditures for individuals without prior coverage as well as for those who substituted their existing coverage for a Part D plan. The decline in total health expenditures measured in this analysis is likely the combination of two effects. The first is the well-documented direct effect of the reduction of drug expenditures after obtaining drug coverage. The second effect may be the result of the substitution of costly medical procedures for prescription drug therapy. Researchers have tried, without success, to establish empirical evidence for this effect (Yang et al. 2009; Kaestner and Khan 2010). Their inability to document a substitution effect may be attributable, in part, to the near-universal insurance coverage afforded to the elderly through Medicare. Medicare may keep the out-of-pocket cost of most medical care low enough, despite cost sharing, that the relative price change from obtaining drug coverage (or more comprehensive coverage) is not substantial enough to foster an observable substitution effect. In other words, the cost of prescription therapy may decline with coverage but not so much that individuals rely on them as opposed to other forms of treatment. While the extent to which each effect contributed to the overall decline in out-of-pocket health expenditures remains uncertain, it is clear from the results of this analysis that Part D was successful in driving down individuals' total health expenditures. If there is an income effect that increases

consumption of health care, the increase in costs associated with consuming more of this good is not large enough to offset the substantial declines in total health expenditures due to prescription coverage.

This analysis indicates that obtaining prescription drug coverage though Part D nearly eliminated the discrepancy in the out-of-pocket health expenditures between the treatment and control groups in this analysis. According to the DID results, after controlling for the covariates in the model, the out-of-pocket expenditures for Group 1 were, on average, $4,311 higher for those without prescription drug coverage compared with those in the Control group in the pre-treatment period. According to the coefficient in the difference-in-difference interaction term, the effect of prescription drug coverage was to reduce this difference by $3,105, on average. This suggests that a vast majority of the difference in pretreatment differences between the out-of-pocket expenditures for this group were attributable to the higher prescription drug costs associated with a lack of drug coverage. This effect is significant at the .001 level. A similar interpretation can be applied to the results for Group 2. Prior to their enrollment in Part D, they spent, on average, $1,264 more than those in the Control group in terms of out-of-pocket medical expenditures. Part D resulted in a decline in out-of-pocket medical expenditures for this group relative to the control of $1,145, on average. The coefficient on the difference-in-difference estimator for this regression just barely misses statistical significance at the .05 level. These results indicate that, in terms of cost, Part D represented an improvement both for those without prior coverage and for those with prior coverage. The finding that Part D lowered out-of-pocket medical expenditures was robust at various levels of expenditures for each group (0<$200,000; 0<100,000; 0<50,000; 0<$25,000; 0<$10,000; 0<$5,000). At each expenditure level, prescription drug coverage

reduced expenditures by a statistically significant amount and almost or entirely eliminated the pretreatment differences between the treatment groups and the control group.

The most important result from the decline in individual health expenditures in general and prescription costs in particular, is the reduction in cost-related non-adherence to prescription therapy. The decrease in the number of individuals reporting that they were forced to cut-back or avoided their prescription regime indicates that Part D successfully achieved one of its specific aims: creating access to affordable health care to those Medicare beneficiaries in need of prescriptions. It is not surprising that this effect was limited to those without coverage prior to Part D because these individuals had the highest rate of non-adherence due to costs and bore the full cost of their prescription medication prior to enrolling in a Part D plan. The 7.9 percentage point reduction in the rate of non-adherence more than halved the pretreatment differences in this measure between those who had and maintained their coverage in the Control group and those without drug coverage prior to the establishment of Part D in Group 1. While differences still remain, the reduction in this discrepancy signifies an important achievement in the effort to expand access to this form of therapy through drug coverage. Improved adherence to due a reduction in costs may also serve as one of the important causal pathways through which the Part D program improves individual health.

The results from this analysis indicate that obtaining prescription drug coverage is associated with a decrease in the likelihood that an individual reported a health decline by 4.3 percentage points, on average. Here again, obtaining prescription drug coverage resulted in a convergence of the means for this outcome between Group 1 and the Control. This suggests a convergence in the relative rates of health deterioration between those who had coverage and

those who recently obtained it through Part D. This result provides evidence that Part D has had a positive effect on health outcomes for Medicare beneficiaries and circumstantial evidence that prescription drug coverage allows individuals to obtain the prescriptions necessary to stabilize their health. Future research may turn towards determining whether the likelihood of a negative health shock is reduced after having obtained prescription drug coverage.

In a re-examination of the general health measure employed by Kaestner and Khan (2010), this analysis found that Part D had small but positive effects on this outcome. The different results may reflect the fact that the estimation samples slightly differ between the two analyses. This analysis includes only those who were taking prescriptions regularly prior to Part D and may, therefore, include individuals whose health may be more responsive to improved access to prescription medications through Part D drug coverage. As noted, the estimation strategy of the Kaestner and Khan (2010) study also had limited statistical power so it is unlikely that their analysis would observed a small treatment effect like those found in this analysis. In this analysis, obtaining drug coverage led, again, to a positive effect on health contributing to the convergence of the mean number of individuals in Group 1 reporting to be in good health with that of the Control group. Combining the results from column 4 of Table 5, indicates that in the pretreatment period those in the Control group were more likely to report being in good health by 6.7 percentage points, in the post-treatment period this difference was nearly zero (6.7 – 6.5 = .02). The Control group appeared to continue the downward trend while the rate of decline was reduced for Group 1. Rather than interpret this change as an improvement in health, it is seen as a reduction in the rate at which

individuals in Group 1 transition from "good" health to "poor" health due to their having enrolled in a Part D prescription drug plan.[22]

This analysis provides evidence that the positive effects of Part D are not limited to reducing prescription costs and increasing consumption of prescription drugs. Indeed, Part D appears to have had a modest but significant positive effect on the health of the elderly. It is plausible that the health effects are the result of increased consumption of prescriptions and/or improved adherence to their prescription regimes. Determining whether these improvements are sustained and if Part D actually improves mortality rates and the quality of life of program enrollees is an interesting area for future research.

[22] I have chosen to interpret the unification of the trend lines as the equalization of the rates of deterioration for each group, rather than a health improvement. This interpretation appears most plausible due to the age and physical condition of the elderly is the actual effect measured because the estimation sample consists of an elderly and/or disabled population whose deterioration is health is evident from the downward slope on the percent of those reporting to be in good health over time (Figure 3: "Percent Reporting Health Declines" and "Percent Reporting to be in Good Health"). I suggest that the aging of this sample over time makes it less likely that these individuals will respond to increased access to prescription medications through drug coverage with improved health and more likely that this access will help equalize the attrition rate of individual health with those that already had access to this treatment in the control group. This would suggest that Part D provides a one-time positive shock to individual health before resuming it downward trajectory. Proof of this hypothesis will require the tracking of these relative trends over time.

Tables and Figures

Table 1: Significant Differences in the Trend Lines between the Treatment and Control Groups, by Year

		Out-of-Pocket Expenditures	Take Less Rx	Health Decline	Good Health
Group 1					
	1998				
	2000	+			
	2002	+			
	2004	+	+		
Group 2					
	1998				
	2000		-		
	2002		-		
	2004		-	-	+

\+ Indicates that trend in the treatment group is increasing more rapidly relative to the control group at a statistically significant rate.

\- Indicates that trend in the treatment group is decreasing more rapidly relative to the control group at a statistically significant rate.

The models used to predict these differences included the full list of explanatory variables in Table 2

Table 2: Variable Means of the Pooled Sample

Dependent Variables (Pooled Sample)	Group 1	Group 2	Control	Possible Control
Total Out-of-Pocket Expend.	6823	4024	3684	4266
Take Less Rx Due to Cost	0.15	0.11	0.03	0.13
Health Gotten Worse	0.33	0.35	0.28	0.26
Good Health	0.64	0.57	0.73	0.75
Explanatory Variables	Group 1	Group 2	Control Group	Control Group
Age	75	73	74	77
BMI	27	28	28	26
Mobility	0.93	1.16	0.56	0.76
Smoker	0.08	0.11	0.07	0.16
Total Assets	175,250	102,000	283,000	
White	0.87	0.80	0.89	0.91
Black	0.11	0.15	0.09	0.08
Other	0.02	0.05	0.02	0.01
Male	0.35	0.31	0.47	0.36
Married	0.58	0.51	0.70	0.53
Some High School	0.27	0.34	0.13	0.26
High School	0.56	0.46	0.59	0.58
Some College	0.03	0.03	0.03	0.06
College/Graduate	0.13	0.17	0.24	0.10
Number of Observations	2402	2042	3972	214

Table 3: Likelihood of Enrolling in Part D and Reporting to Take Less Prescriptions Due to Costs

	Group 1	Group 2	Group 1	Group 2
	Enrolled in Part D	Enrolled in Part D	Take Less	Take Less
Rx Costs Partly Covered		**0.222*** **		
		(0.017)		
Take Rx Regularly	**0.147*** **			
	(0.010)			
Log(Prescription Costs)			**0.024*** **	**0.031*** **
			(0.009)	(0.009)
Log(Total Assets)	0.007***	-0.032***	-0.023***	-0.016***
	(0.001)	*(0.003)*	*(0.004)*	*(0.004)*
Age	-0.086***	-0.045***	-0.012***	-0.007***
	(0.007)	(0.014)	(0.001)	(0.002)
Age Squared	0.001***	0.000***		
	(0.000)	(0.000)		
Black	-0.023**	0.022	0.004	-0.009
	(0.010)	(0.027)	(0.038)	(0.038)
Male	-0.030***	-0.079***	-0.064***	-0.004
	(0.007)	(0.018)	(0.024)	(0.026)
Married	-0.009	-0.095***	-0.046*	-0.022
	(0.007)	(0.020)	(0.025)	(0.027)
Some College	-0.014	-0.022	-0.041	-0.015
	(0.019)	(0.046)	(0.057)	(0.063)
College	-0.035***	-0.002	-0.056*	0.038
	(0.009)	(0.021)	(0.033)	(0.030)
Good Health	-0.006	-0.102***	-0.133***	-0.077***
	(0.007)	(0.019)	(0.024)	(0.025)
Constant	3.395***	2.595***	1.382***	0.692***
	(0.265)	(0.503)	(0.113)	(0.120)
Observations	10159	2783	1153	765

[a b] The outcome is a binary indicator equal to 1 if the individual reported enrolling in Part D in 2006 and 0 otherwise.

[a] The estimation sample consists of all individuals with and without prescription drug coverage in 2004

[b] The estimation sample consists of only those who reported having prescription drug coverage in 2004

[c d] The outcome is a binary indication equal to 1 if the individual reported taking less medications than prescribed to them due to costs and 0 otherwise

Table 4: Regression Results Looking at Differences in Pre-Treatment Trends

	PANEL A				PANEL B			
	Group 1				Group 2			
	OOP Medical Expenditures	Take Less Rx Due to Cost	Reports Health Decline	Reports Good Health	OOP Medical Expenditures	Take Less Rx Due to Cost	Reports Health Decline	Reports Good Health
Treat*2004	4005.3***	0.0753**	0.0398	-0.0382	922.2	-0.115**	-0.117**	0.103**
	(902.137)	(0.038)	(0.042)	(0.041)	(614.677)	(0.051)	(0.054)	(0.052)
Treat*2002	1753.1**	0.0469	0.0161	-0.00348	595.0	-0.113**	-0.0923*	0.0705
	(694.532)	(0.038)	(0.043)	(0.041)	(649.841)	(0.052)	(0.055)	(0.053)
Treat*2000	1399.6**	0.0421	0.0178	-0.0132	229.4	-0.106**	-0.0758	0.0689
	(616.208)	(0.038)	(0.043)	(0.042)	(511.103)	(0.052)	(0.055)	(0.053)
Treat* 1998	460.9	-0.0166	0.0300	0.0380	721.1	-0.0944*	-0.0487	0.0561
	(564.244)	(0.038)	(0.046)	(0.044)	(564.967)	(0.053)	(0.058)	(0.056)
Treatment	309.4	0.0611*	-0.00182	-0.0333	316.4	0.172***	0.134***	-0.163***
	(529.397)	(0.036)	(0.039)	(0.038)	(454.731)	(0.050)	(0.051)	(0.050)
2004	1878.0***	0.0410**	0.132***	-0.146***	1790.1***	0.0247	0.128***	-0.143***
	(337.010)	(0.016)	(0.026)	(0.026)	(327.207)	(0.015)	(0.026)	(0.027)
2002	1687.9***	0.0394**	0.121***	-0.143***	1523.4***	0.0223	0.116***	-0.140***
	(331.067)	(0.016)	(0.026)	(0.026)	(317.344)	(0.015)	(0.027)	(0.027)
2000	465.0*	0.0345**	0.0727***	-0.120***	245.0	0.0176	0.0675**	-0.117***
	(265.506)	(0.016)	(0.026)	(0.026)	(246.963)	(0.015)	(0.027)	(0.027)
1998	324.1	0.0227	0.0951***	-0.162***	129.7	0.00953	0.0923***	-0.162***
	(260.371)	(0.016)	(0.028)	(0.028)	(242.884)	(0.015)	(0.028)	(0.029)
Smoker	-576.6**	0.0136	0.0251	-0.0414**	-262.1	0.0190*	0.0301*	-0.0321*
	(265.169)	(0.011)	(0.017)	(0.017)	(256.598)	(0.011)	(0.018)	(0.017)
Mobility t-1	643.1***	0.0295***	0.0751***	-0.110***	373.8***	0.0176***	0.0750***	-0.114***
	(118.219)	(0.003)	(0.004)	(0.004)	(76.227)	(0.003)	(0.004)	(0.004)
Overweight	286.8	0.00237	0.00266	0.0158*	-68.22	-0.00864	-0.00462	0.0139
	(234.969)	(0.006)	(0.010)	(0.009)	(193.969)	(0.005)	(0.010)	(0.009)
Underweight	-413.1	-0.0383**	0.0556	-0.0596	-1071.6**	0.0133	0.0995**	-0.118***
	(795.930)	(0.016)	(0.042)	(0.039)	(429.382)	(0.024)	(0.049)	(0.045)

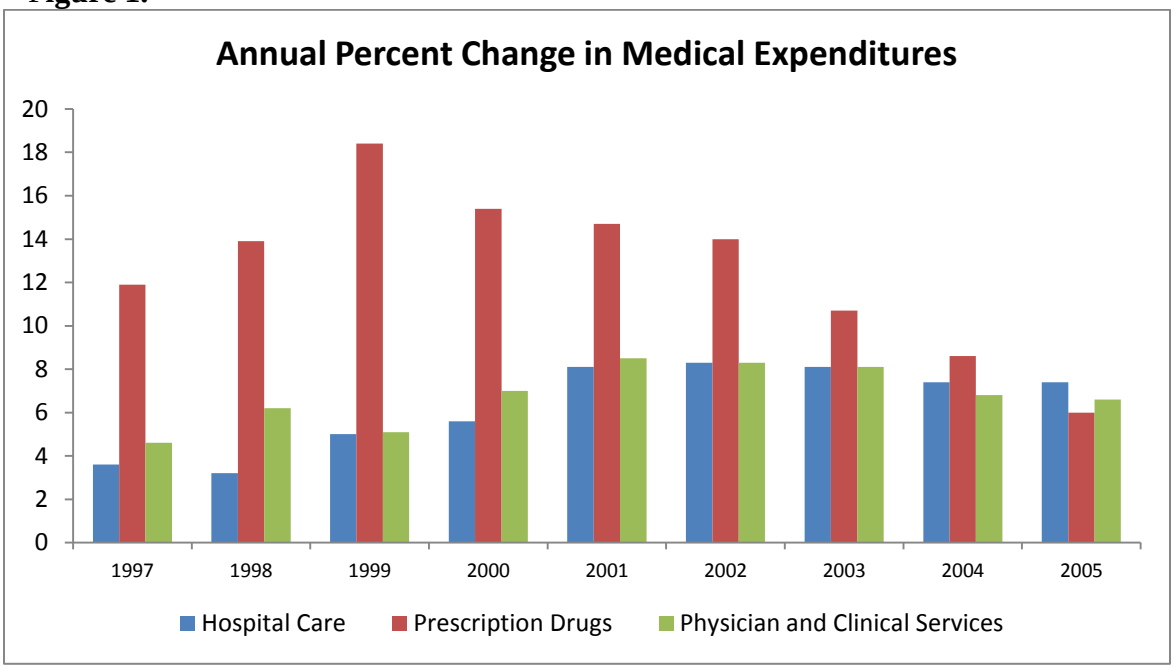
Log(Assets)	132.3***	-0.0137***	-0.00569***	0.0159***		229.8***	-0.00624***	-0.00608***	0.0175***
	(43.219)	(0.002)	(0.002)	(0.002)		(34.795)	(0.001)	(0.002)	(0.002)
Age	-1005.3***	-0.0259***	-0.0569***	0.121***		-326.7**	-0.0153**	-0.0287***	0.0714***
	(352.484)	(0.007)	(0.011)	(0.010)		(163.022)	(0.007)	(0.011)	(0.014)
Age Sq.	7.046***	0.000143***	0.000415***	-0.000809***		2.251*	0.0000837*	0.000225***	-0.000474***
	(2.452)	(0.000)	(0.000)	(0.000)		(1.163)	(0.000)	(0.000)	(0.000)
Black	252.3	0.0514***	-0.00770	-0.105***		400.5	0.0229**	-0.0511***	-0.0651***
	(567.078)	(0.012)	(0.016)	(0.017)		(540.730)	(0.011)	(0.016)	(0.016)
Male	-266.5	-0.0163***	-0.0102	-0.0673***		-574.5**	-0.00225	-0.00606	-0.0795***
	(240.110)	(0.005)	(0.009)	(0.009)		(224.514)	(0.005)	(0.010)	(0.010)
Married	-274.6	-0.0108	0.0204*	-0.00216		291.7	-0.00180	0.0215*	-0.00576
	(311.868)	(0.007)	(0.011)	(0.010)		(254.170)	(0.007)	(0.012)	(0.011)
Some College	371.5	0.00860	-0.0102	0.0272		1165.2	-0.00436	-0.0114	0.0247
	(668.896)	(0.015)	(0.024)	(0.021)		(793.514)	(0.014)	(0.027)	(0.024)
College	396.1	0.000520	0.00149	0.0602***		301.7	0.00165	-0.00601	0.0617***
	(315.786)	(0.005)	(0.011)	(0.009)		(198.566)	(0.005)	(0.012)	(0.010)
Constant	35084.8***	1.252***	2.044***	-3.628***		10372.2*	0.730***	1.023***	-1.835***
	(12711.433)	(0.274)	(0.396)	(0.370)		(5742.363)	(0.258)	(0.387)	(0.513)
N =	9218	9025	9211	9215		8078	7929	8072	8074

Table 5: Difference-in-Difference Regressions

	PANEL A				PANEL B			
	Group 1				**Group 2**			
	OOP Medical Expenditures	Take Less Rx Due to Cost	Reports Health Decline	Reports Good Health	OOP Medical Expenditures	Take Less Rx Due to Cost	Reports Health Decline	Reports Good Health
Treatment	4,311***	0.144***	0.038**	-0.067***	1,263.9***	0.059***	0.019	-0.047***
	(741.533)	(0.011)	(0.017)	(0.015)	(443.983)	(0.011)	(0.019)	(0.018)
Post	-447.2	0.012**	-0.008	-0.041***	-207.6	0.011*	-0.009	-0.038***
	(330.969)	(0.006)	(0.014)	(0.013)	(318.083)	(0.006)	(0.014)	(0.013)
Treatment*Post	**-3,105*** **	**-0.079*** **	**-0.043***	**0.065*** **	**-1,145***	**-0.015**	**0.012**	**0.020**
	(862.793)	**(0.015)**	**(0.024)**	**(0.022)**	**(595.436)**	**(0.015)**	**(0.025)**	**(0.023)**
Smoker	-483.5	0.029**	0.048**	-0.083***	-271.3	0.006	0.050**	-0.051**
	(406.767)	(0.015)	(0.023)	(0.022)	(376.274)	(0.013)	(0.022)	(0.021)
Mobility t-1	1,020.7***	0.024***	0.080***	-0.116***	509.9***	0.016***	0.075***	-0.116***
	(181.606)	(0.003)	(0.005)	(0.004)	(111.185)	(0.003)	(0.005)	(0.004)
Overweight	381.3	0.006	-0.017	0.028**	-233.1	0.001	-0.010	0.018
	(354.416)	(0.007)	(0.012)	(0.011)	(319.700)	(0.006)	(0.013)	(0.012)
Underweight	1955.0	-0.006	0.063	-0.098**	318.247	0.015	0.127**	-0.173***
	(1,479.940)	(0.020)	(0.049)	(0.047)	(1,104.894)	(0.024)	(0.051)	(0.048)
Log(Total Assets)	112.2	-0.009***	-0.008***	0.013***	224.1***	-0.009***	-0.006***	0.015***
	(94.248)	(0.002)	(0.002)	(0.002)	(37.705)	(0.002)	(0.002)	(0.002)
Age	-965.0**	-0.006***	-0.036***	0.036***	-699.4***	-0.004***	-0.013	0.031**
	(404.207)	(0.001)	(0.013)	(0.013)	(253.570)	(0.001)	(0.012)	(0.012)
Age Squared	7.0**		0.000***	-0.000**	5.1***		0.000	-0.000**
	(2.713)		(0.000)	(0.000)	(1.765)		(0.000)	(0.000)
Black	217.0	0.052***	-0.049**	-0.062***	335.4	0.009	-0.089***	-0.035*
	(830.308)	(0.014)	(0.019)	(0.020)	(742.802)	(0.012)	(0.019)	(0.020)
Other	-933.6*	0.037	0.018	-0.054	-1,366.4***	-0.024	-0.075**	-0.013
	(565.686)	(0.028)	(0.042)	(0.042)	(420.408)	(0.021)	(0.036)	(0.035)
Male	-177.8	-0.010	0.016	-0.089***	-441.0	0.003	0.015	-0.087***
	(344.671)	(0.007)	(0.012)	(0.011)	(290.798)	(0.006)	(0.013)	(0.012)

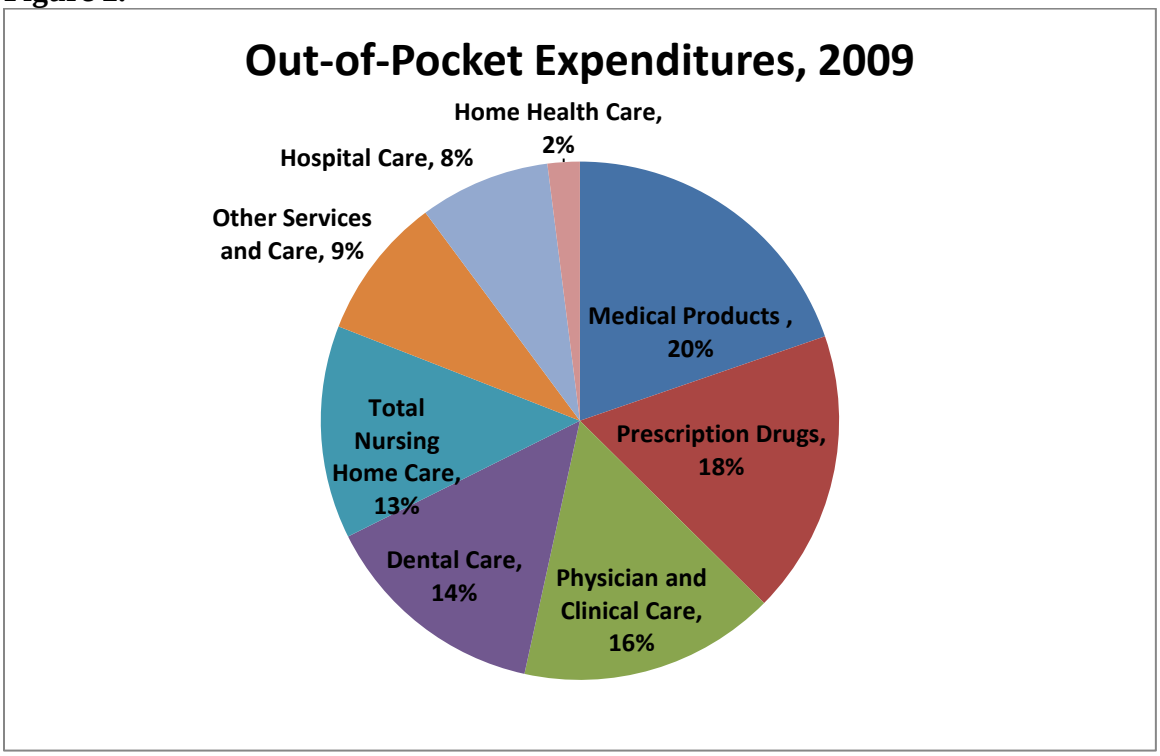
Married	-726.4	-0.020**	0.006	0.031**	-295.7	-0.001	0.009	0.015
	(447.672)	(0.008)	(0.014)	(0.013)	(330.561)	(0.007)	(0.014)	(0.013)
High School	993.7*	0.005	-0.020	0.118***	655.590*	0.012	-0.015	0.093***
	(516.960)	(0.010)	(0.016)	(0.016)	(397.379)	(0.010)	(0.017)	(0.017)
Some College	170.4	0.006	-0.076**	0.131***	1158.8	-0.009	-0.090***	0.089***
	(681.955)	(0.019)	(0.033)	(0.030)	(717.625)	(0.015)	(0.033)	(0.032)
College	2,047.0***	0.006	-0.029	0.170***	1,448.4***	0.022**	-0.042**	0.138***
	(698.334)	(0.011)	(0.020)	(0.019)	(456.643)	(0.011)	(0.020)	(0.019)
Constant	33,653.3**	0.554***	1.533***	-0.798	23,903.3***	0.405***	0.596	-0.568
	(15,172.353)	(0.049)	(0.497)	(0.489)	(9,029.592)	(0.045)	(0.436)	(0.457)
Observations	6087	6085	6085	6083	5757	5755	5752	5754
R-Squared	0.032	0.127	0.084	0.208	0.018	0.073	0.084	0.227

Figure 1.



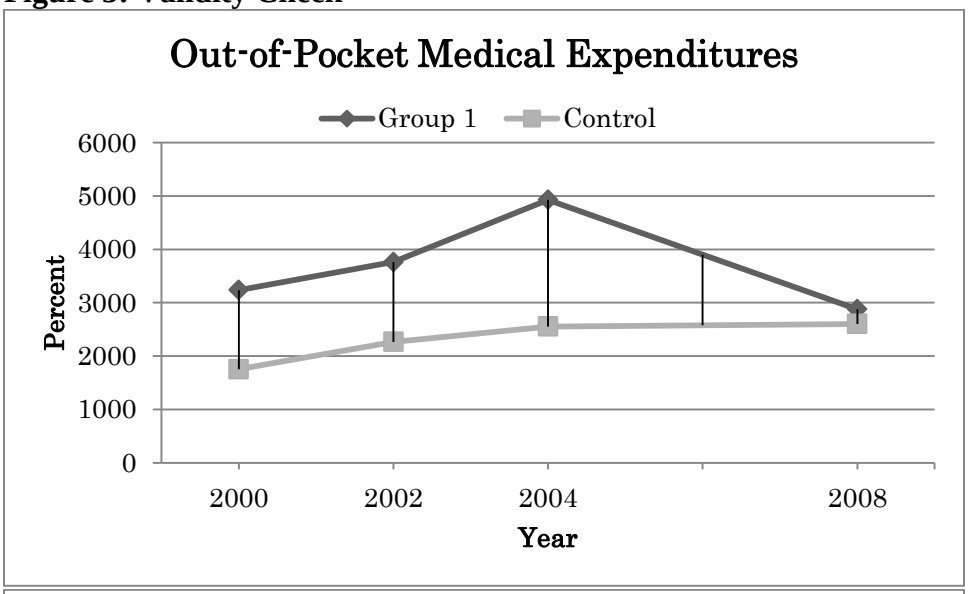
Source: Kaiser Family Foundation: Presciption Drug Trends (2010). Data were taken from the National Health Expenditure Data. Centers for Medicare and Medicaid Services.

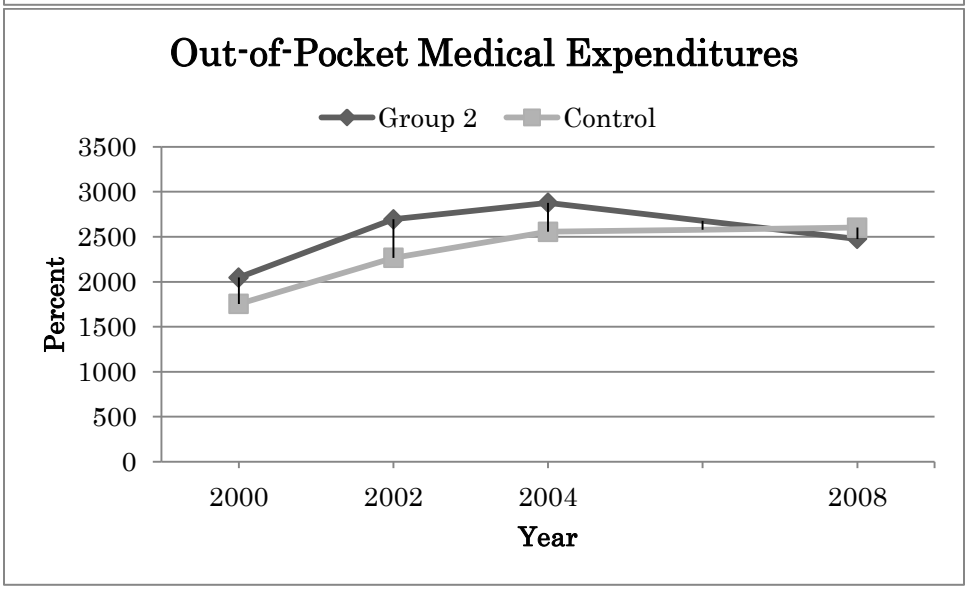
Figure 2.

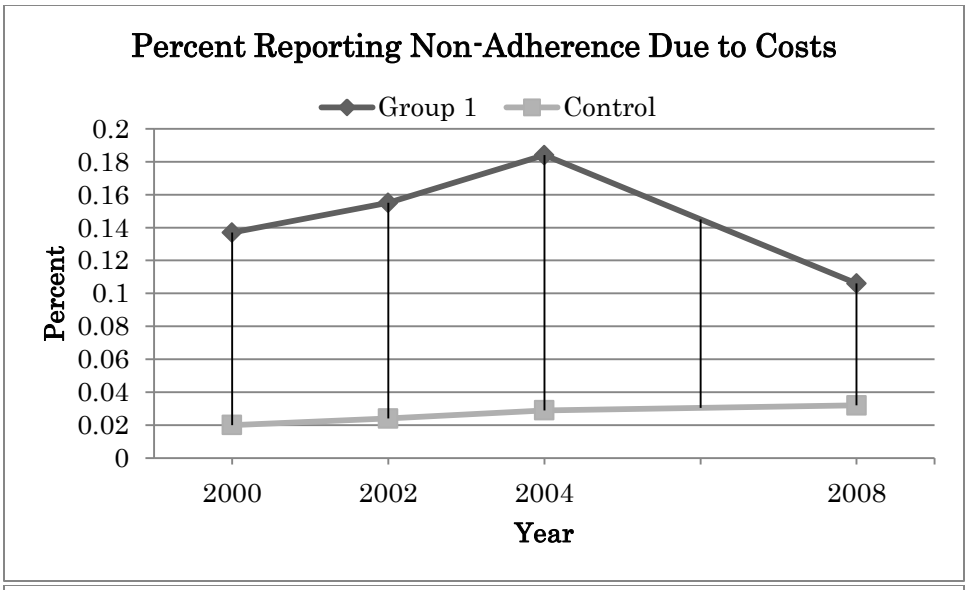


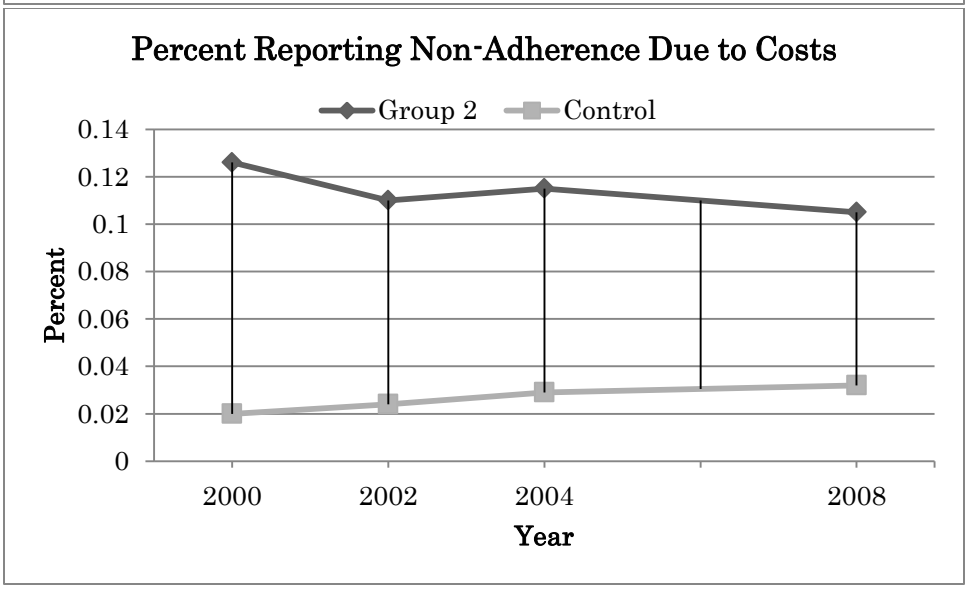
Source: Data complied from the National Health Expenditure Data. Centers for Medicare and Medicaid Services. 2009

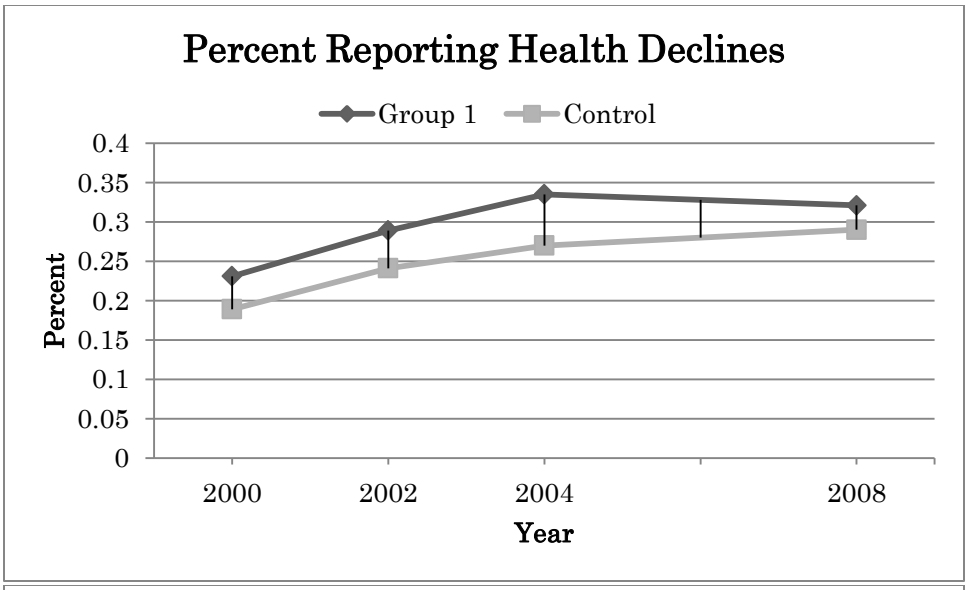
Figure 3: Validity Check

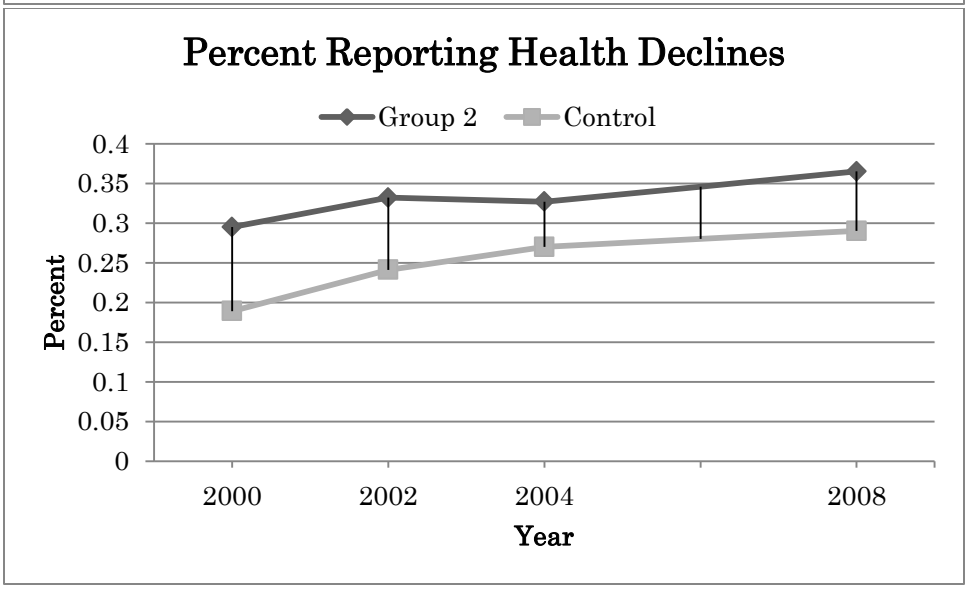


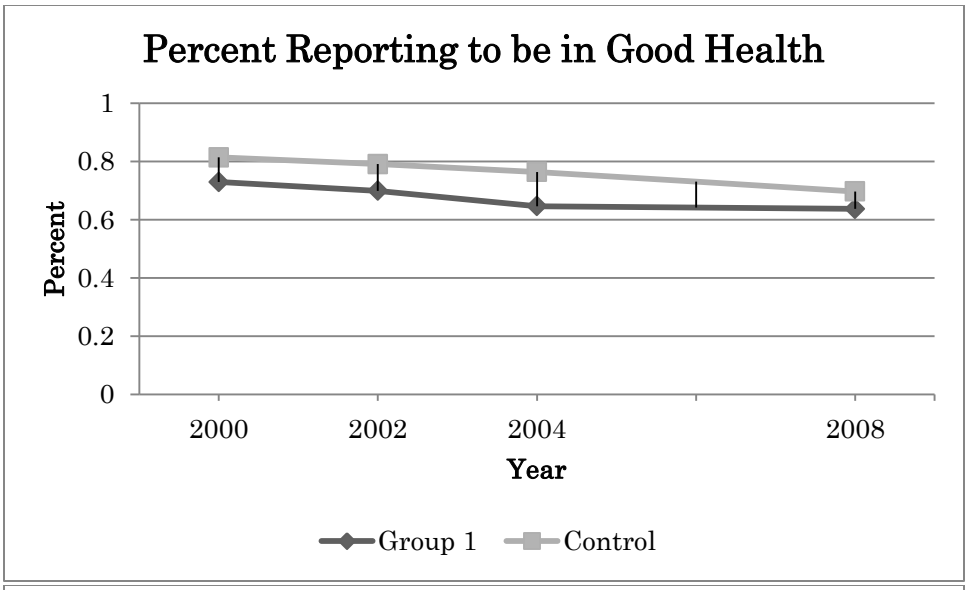


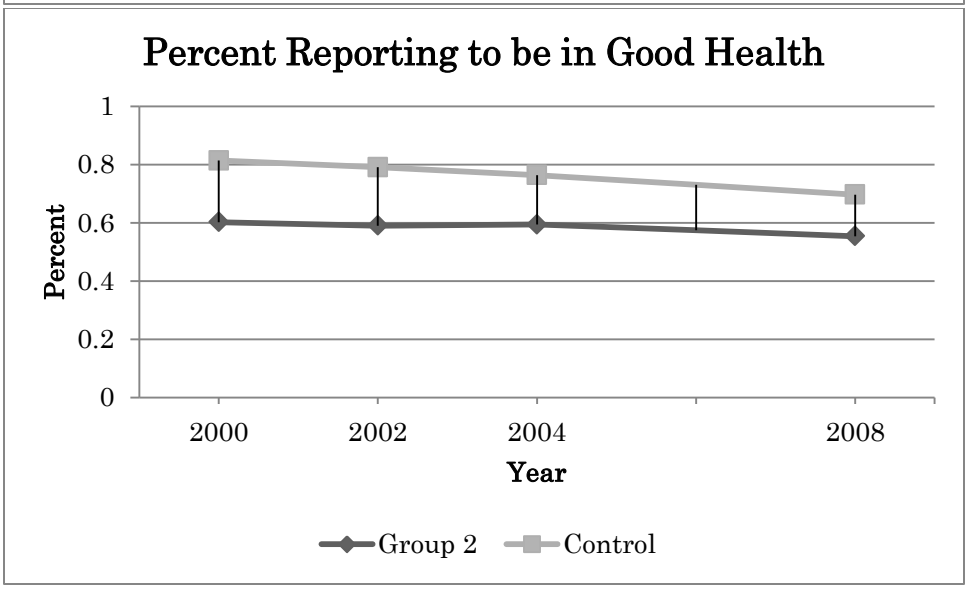

Percent Reporting Non-Adherence Due to Costs
Group 1
Control
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Percent
2000
2002
2004
2008
Year


Percent Reporting Non-Adherence Due to Costs
Group 2
Control
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Percent
2000
2002
2004
2008
Year


Percent Reporting Health Declines
Group 1
Control
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Percent
2000
2002
2004
2008
Year


Percent Reporting Health Declines
Group 2
Control
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Percent
2000
2002
2004
2008
Year


Percent Reporting to be in Good Health
1
0.8
0.6
0.4
0.2
0
Percent
2000
2002
2004
2008
Year
Group 1
Control


Percent Reporting to be in Good Health
1
0.8
0.6
0.4
0.2
0
Percent
2000
2002
2004
2008
Year
Group 2
Control

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CHAPTER 3

FINANCIAL LITERACY AND PENSION ACTIVITY AMONG THE ELDERLY

Introduction

Researchers have increasingly focused their attention on establishing and analyzing the link between financial literacy and sub-optimal financial decision-making (Lusardi and Mitchell 2011). The theme undergirding much of this research is that individuals are not sufficiently informed to behave optimally and maximize their welfare which, in turn, leads to a number of welfare reducing mistakes including under-saving for retirement, under-annuitizing their wealth upon retirement, holding undiversified portfolios, and failing to refinance a mortgage (Campbell 2006; Brown 2007; Lusardi and Mitchell 2007). From this perspective, it follows that increasing financial sophistication through financial literacy will lead individuals to make more informed economic choices. Therefore, it is important to first, establish whether the financial literacy is actually associated with what are commonly viewed as better financial decisions.

This paper will employ a financial literacy index to explore the relationship between financial literacy and three different retirement-related financial decisions: the timing of an individual's decision to claim their Social Security benefits, the level of "time diversification" within their portfolios, and how actively they manage their defined contribution pension accounts. Each of these outcomes has important implications for the financial well-being and exposure to financial risk for workers in, or approaching retirement. While failing to minimize risk exposure through informed investment and Social Security

claiming decisions will not, necessarily, lead to suboptimal outcomes, poor economic choices can increase the financial risks associated with retirement.

This paper builds on the existing body of research within the financial literacy field by analyzing the relationship between this construct and three outcomes that have yet to be analyzed within the field: Social Security claiming behavior, the extent to which households age-weight their financial portfolio—referred to as being time diversified—and pension activity. Like other analyses in this field, the financial literacy index is comprised of responses to financial questions that are either correct or incorrect. In contrast, previous studies have frequently relied on indices constructed from a mix of factual and subjective components such as individual sentiment that may not reveal much about the individuals actual level of financial sophistication (Hung, Meijer, Mihaly, and Yoong 2009; Kimball and Shumway 2010).[23]

Financial Literacy

As the review by Huston (2010) makes clear, financial literacy is a construct without a common definition; however, the literature consistently demonstrates that a substantial share of the population cannot perform the basic economic calculations and lack an understanding of simple financial concepts typically used to define this measure (Lusardi 2008; Lusardi, Mitchell and Curto 2009; Kimball and Shumway 2010). Large majorities of individuals are unable to perform basic interest and debt-related calculations like those associated with a credit card balance (Lusardi and Mitchell 2007; Lusardi and Tufano 2009). Many people are unable to correctly identify appropriate financial behaviors or fully

[23] These questions may ask the respondent to respondent with "True" or "False" to a statement like the following: "I can usually tell when it is a good time to buy or sell a stock. These questions do not measure objective knowledge but a person's subjective sense of their own known knowledge. This may be problematic because individuals have been shown to over-estimate what they actually know with respect to financial matters (OECD 2005).

comprehend the consequences of certain financial decisions (Hilgert, Hogarth, and Beverly 2003). Individuals also appear to be exceedingly uninformed with respect to financial markets as a substantial share of individuals are unable to identify fundamental financial concepts such as diversification and fail to grasp even the basics about investment risk or asset prices (Kimball and Shumway 2010; Lusardi, Mitchell and Curto 2009; Lusardi and Mitchell 2007; van Rooji, Lusardi and Alessie 2007).

The apparent lack of financial literacy documented in these studies has potentially important implications for understanding financial decision-making as well as financial outcomes for individuals. As Willis (2011) points out however, there is no causal link between financial literacy and improved financial outcomes but financial literacy does appear to be positively correlated with better financial behaviors and more informed decision-making. Lusardi and Mitchell (2009 and 2007) found that the financially literate are more likely to have planned for retirement and were more likely to have higher levels of wealth. The financially literate are also more likely to participate in the stock market and their company's pension plan as well as engage in sophisticated investment behaviors (van Rooji, Lusardi and Alessie 2007; Goetzmann and Kumar 2008; Agnew, Szykman, Utkus and Young 2011). Hilgert, Hogarth and Beverly (2003) found that the financially literate were more likely to engage in better financial management behaviors and were more likely to save and invest for the future. Scholars have also shown that a lack of financial literacy is associated with higher debt loads and a higher likelihood of borrowing from a pension plan to cover current expenses (Lusardi and Tufano 2009; Agnew, Szykman, Utkus and Young 2011).

This analysis will attempt to build on the existing research and analyze the relationship between three different financial decisions related to retirement: the timing of

their decision to claim their Social Security benefits, the distribution of their assets within their household portfolio, and whether they are more likely to have ever changed the assets within their defined contribution plan.

Social Security Claiming Behavior

Social Security represents one of the largest and most important social policy programs in the United States. Individuals pay into the Social Security system throughout their working lives and receive a monthly benefit, the amount of which is determined, in part, by the lifetime earnings of the individual. The program is intended to keep senior citizens out of poverty after they have transitioned out of the labor force and into retirement. The most recent estimates from the Social Security Administration (2011) indicate that Social Security covers nine out of ten individuals over the age of 65 and serves as the primary source of income for 63 percent of elderly households (65 and over) living in the United States.

Those eligible to participate in this program may begin to claim benefits as early as age 62 but may also elect to defer receiving them until age 70. The age at which an individual decides to claim their Social Security benefits affects their monthly benefit level. Individual benefit levels are determined by the earnings history of the individual but this benefit can be further reduced or increased depending on the age at which an individual files to begin receiving their benefits.

An individual will receive a permanent reduction in their monthly benefit level if they claim their benefits prior to their "Full Retirement Age" (FRA) and a permanent increase in their monthly benefit level for delaying the decision to claim their benefits until after their FRA. An individual's FRA is set by the Social Security Administration and determined by the year in which that individual was born (see Table 1). The penalty for claiming prior to

one's FRA is clear from column 5 of Table 1, where for example, the FRA for a person born in 1950 is age 66. If a man eligible for Social Security was born in 1950 were to claim his benefits at age 62, his monthly retirement benefit would be reduced by 25 percent.[24] Alternatively, if he were to wait until he was 70 to claim his benefits, he would receive a 32 percent increase in his monthly benefit (column 7 in Table 1 and Figure 1). In other words, when age 62 is used as the reference point, the benefit level of this individual increases each month that he delays claiming his Social Security benefits past this point. For this particular individual, the share of his total benefit would increase by .56 percentage points per month past turning 62 until he turned 65, at which point the share would increase by roughly .42 percentage points per month until he reached his FRA of 66 whereupon he would receive his full benefit. His benefit level would continue to increase as a share of his full benefit by roughly .67 percentage points for each month he continues to delay claiming his benefits past his FRA until he turns age 70.

As this example illustrates, the benefit structure with respect to the timing of the Social Security claiming decision allows individuals to choose between receiving a smaller benefit for a longer period of time or a larger benefit for a shorter period of time. However, the Social Security Administration states that, in general, the timing of this decision will result in the approximately the same total level of benefits over the lifetime of the individual which is true for those workers with average life expectancies (Sass, Sun and Webb 2007; Meyer and Reichenstein 2010). For these individuals the changes in Social Security benefit levels associated with the timing of the claiming decision do not significantly alter the expected present value of their benefits because the reductions and increases associated with the

[24] The size of this penalty increases for later generations such that a person born in 1960 would have their monthly benefit reduced by 30 percent.

timing of their decision are actuarially fair. Therefore, once eligible, the timing of their claiming decision will not have a substantial affect (positive or negative) on the total amount of benefits they can expect to receive from the program over time. The same cannot be said for those with anything other than an average life expectancy. For these individuals, the timing of their claiming decision will determine the total amount of benefits they can expect to receive (the expected present value) as well as help determine their exposure to longevity risk, that is, the risk of outliving their assets. Those individuals with short life expectancies would benefit from claiming Social Security before their FRA, and those with long life expectancies benefit from delaying their claiming decision (See Table 2).

Social Security Claiming Behavior and Financial Literacy

While it is impossible to know the optimal age at which one should initiate their Social Security benefits, individuals can make more informed decisions by incorporating their individual-specific circumstances such as life expectancy, stock of wealth, time preferences, and marital and employment status into their decision. The data however, indicate that an overwhelming and increasing majority of individuals are not adjusting their claiming decision to accommodate changing circumstances. For example, in 2009, 74 percent of Social Security beneficiaries received a reduced benefit due to their decision to claim their benefits before their FRA; this figure is up 20 percent since 1980 while, over the same period, the average life expectancy at age 65 has increased by 13 percent (2.2 years) (National Center for Health Statistics 2011; Social Security Administration 2011). If individuals were actually integrating changes in their expected longevity into their claiming decision, one would expect the percentage of those receiving reduced benefits to be negatively correlated with longevity. The fact that individuals are living longer and claiming

Social Security benefits earlier calls into question whether individuals are being rational with respect to the timing of their claiming decision.

While these trends provide only circumstantial evidence that many individuals are not maximizing their benefit, researchers have come to similar conclusions in more formal analyses of data collected from Social Security beneficiaries. Coile, Diamond, Gruber, and Jousten (2002) found that the prevalence of delay in the claiming decision is much lower than estimates from theoretical models would suggest. They used single households and one-earner couples to demonstrate that the decision to delay claiming Social Security benefits is optimal under various circumstances and doing so can result in large increases in an individual's total and monthly benefit level. By contrast, those that claim their benefits prior to their FRA, stand to lose thousands of dollars worth of Social Security benefits (Meyer and Reichenstein 2010; Sass et al., 2007). Married households would also be substantially better-off by delaying their Social Security benefits as they could smooth their consumption over the duration of their retirement and increase the survivor benefit of elderly widows (Sun and Webb 2009). Sun and Webb (2009) also estimate that a large minority of these couples have sufficient financial assets to fund their consumption while delaying their receipt of Social Security benefits from 62 to 66 (46 percent of married households) and 62 to 68 (40 percent) suggesting that many of those who choose to receive their benefits early are not doing so out of necessity.

Models based on standard economic theories cannot sufficiently explain why so many claim their benefits early when it is neither rational nor welfare maximizing. A more satisfying explanation may come from the literature on behavioral economics and financial literacy. The former is a sub-field of economics devoted, in large part, to the identification

and explanation of observed financial behavior that systematically deviates from the expectations of standard economic models. Researchers in this field have found that individuals are often unwilling or unable to make the welfare maximizing decision when their choice involves uncertainty (Thaler 1985; Benartzi and Thaler 2007; Choi, Laibson, Madrian 2011; Choi, Laibson, Madrian 2010; Choi, Laibson, Madrian, and Metrick 2006). In the presence of uncertainty, their financial behavior is frequently motivated by heuristics, or biases (such as loss aversion), and lead to preferences being easily manipulated by the "framing" of the information presented to the individual (Tversky and Kahneman 1974). The findings from this field are inconsistent with the expectations of the standard economic model populated with fully rational, welfare maximizing individuals who have stable and well-defined preferences.

Researchers have, therefore, recommended that, where possible, public policies be designed so that they unobtrusively correct the welfare reducing behavior of individuals by incorporating such behavior into the policy design (Thaler and Sunstein 2008). The most successful of such policies has demonstrated that adjusting the default setting of individual enrollment in their company's pension plan and their savings amount over time can increase pension plan participation and saving rates (Choi, Laibson, Madrian, and Metrick 2006; Thaler and Benartzi 2004). By allowing for automated enrollment and adjustments in saving rates, these policies exploit tendency of individuals towards inertia and procrastination to increase their pension plan participation and increase individual saving rates.

With respect to Social Security claiming behavior, Brown, Kapteyn, and Mitchell (2011) found that an individual's expected claiming date was highly responsive to how claiming information was framed. They provide evidence that the "breakeven analysis" used by the

Social Security Administration (SSA) to explain to individuals how their benefit level will vary depending on the timing of their claiming decision. When explaining the difference between claiming at, say, age 62 and 63, the SSA would describe the decision to delay until 63 as a forfeiture of the benefits that the individual would have otherwise received by claiming at age 62. The SSA would also include information detailing how long it would take the individual to "breakeven" from their decision to defer to their claiming decision to, in this example, age 63 over age 62. The individual is said to break even at the point when he/she has lived long enough under the higher payment schedule from claiming at 63 to account for one year loss of benefits from not claiming at age 62. This method of explanation is thought to increase the rate at which individuals claim early because it emphasizes the losses from delaying their decision and conditions recouping those losses upon an uncertain survival to a specific time period. This possibility draws upon one of the most robust findings from the field of behavioral economics, mainly, that individuals prefer a benefit that is certain over one that is uncertain due to "loss aversion" (Khaneman and Tversky 1974'; Benartzi and Thaler 1995). Brown, Kapteyn, and Mitchell (2011) apply these concepts to Social Security information and show that by avoiding framing the information as the loss of the benefits from delaying their claiming decision and emphasizing, instead, the gain from a higher monthly benefit, the SSA may be able to reduce the number of individuals that claim early.

In addition to modifications in the design of certain policies, the idea of improving financial literacy has become an increasing popular field of inquiry among researchers interested in understanding economic behavior. Financial literacy has been shown to reduce individuals' tendency towards welfare-reducing biases and non-rational financial behavior (Feng and Seasholes 2005; Liu, Wang, and Zhao 2010; Choi, Laibson, and Madrian 2011;

Brown, Kapteyn, and Mitchell 2011). These studies suggest that financially literate individuals are less susceptible to welfare-reducing biases and tend to behave more rationally when making financially-related decisions. It is impossible to determine whether this apparent relationship is causal, but it is possible to formulate plausible hypotheses regarding the causal pathways through which such an effect may operate. Financial literacy may help reduce some of the complexity and search costs associated with financial decision-making and reduce the uncertainty that may otherwise lead individuals to act on their non-rational behavioral impulses, cognitive biases, or misguided heuristics. The financially literate may be better able to identify important economic information and incorporate the relevant facts into their decision and reach a consistent conclusion regardless of the manner in which they are presented. This interpretation would help explain why the behavior of the financially literate appear to be less responsive to the framing with respect to anticipated claiming dates and the frames employed by Brown, Kapteyn, and Mitchell (2011). If the financially literate are less susceptible to framing effects and the current frame employed by the Social Security Administration actually increases the likelihood of claiming early, then one might expect that the financially literate would be less likely to claim their benefits early.

It is, however, unclear whether, or the extent to which, Social Security factors into household saving decisions and their plans for retirement. Given the importance of Social Security income to retired households, one would expect that the timing of benefit receipt and benefit levels would be central to many, if not most, most retirement-related planning and saving decisions. However, the evidence suggests that very few people are adequately informed with respect to their Social Security benefits. Combining data from the Social Security Administration and the Health and Retirement Study (HRS), Gustman and

Steinmeier (2005) reported that only 27 percent of those approaching retirement were able provide an estimate of their anticipated Social Security benefit within 75 to 125 percent of their actual benefit level. Almost three quarters either "did not know" what they could expect to receive from Social Security in retirement or provided an estimate that either grossly under- or over-estimated their actual benefit. The results from a survey conducted by the Helman, Greenwald, VanDerhei, and Copeland (2007) found that only 18 percent of workers were able to correctly identify their FRA. In a related study, Clark, Morrill, and Allen (2010) also found that only a small minority knew the rate at which their benefits would be reduced as a result of claiming their benefits before their FRA and it was clear to roughly half of those surveyed were aware that this penalty was permanent.[25]

In an effort to educate workers about their benefits, the SSA began distributing annual Social Security statements to all workers eligible for the program in 1995. These statements detailed the different benefit levels the worker could expect to receive at different claiming ages. However, these statements do not appear to have impacted the claiming patterns or expected claiming age of individual's eligible for Social Security (Mastrobuoni 2011). It is not clear, however, whether knowledge of the Social Security program varies according to financial literacy. Gustman, Steinmeier, and Tabatabai (2010) found that general cognition does not appear to predict whether individuals are aware of their Social Security benefits; though general cognition is a separate construct from financial literacy that does not measure the same type of subject-specific knowledge that may be more relevant to understanding the type of relationships within their study. Only one study obtained by this author touched upon

[25] Their estimates were not based on nationally representative sample of individuals. They were drawn from individuals employed at three large firms in North Carolina. Their sample is more educated than the general population and it is likely, therefore, that they understate the lack of knowledge individuals possess regarding their Social Security benefits at the national level.

this relationship. Chan and Stevens (2008) established that well-informed individuals are more responsive to their pension incentives for retirement at specific ages due to the structure of their plan and that, instead of being unresponsive, individuals that are misinformed regarding those incentives respond to their incorrect perceptions of them. Again, being "well-informed" with respect to one's pension is not the same as being financially literate, but it does suggests that those that understand their pensions are more likely to take advantage of the incentives within in them and if the financially literate are better informed of their benefits and the incentive structure associated with the timing of their claiming decision in the Social Security program, they may be more likely to delay their decision. As financial literacy appears to be associated with more constructive retirement-related behavior, higher levels of wealth, and less debt, it may also allow individuals to understand, or actually estimate, the consequences of early claiming decisions using the information provided by the Social Security Administration.

Financial literacy may also simply result in a backwards adjustment in an individual's subjective time preferences. Education is considered an important determinant of individual time preferences, and those with more education have been shown to have lower personal discount rates that measure the rate at which an individual trades current for future benefits (Becker and Mulligan 1997; Warner and Pleeter 2001; Hansel and Deichert 2008; Tanaka, Camerer, and Nguyen 2010). In other words, more highly educated individuals tend to be more patient and place a lower premium on the immediacy of specific benefits. While the relationship between education and personal discount rates is likely endogenous (Meier and Springer 2007), there is evidence indicating a causal relationship (Perez-Arce 2011). Like education, financial literacy may also affect an individual's time preferences because it is

simply a more specific form of education. Indeed, the subject matter that often composes this concept can frequently stress the importance of patience and self-control with long-run investment vehicles and due to extended investment time horizons. One can reasonably argue, then, that the timing of individuals' claiming decisions are determined, in part, by their subjective time preferences and that financial literacy would contribute to the establishment of these time preferences and help individuals align their time preferences with their individuals-specific circumstances, which for most people would result in a later claiming date.

Therefore, analysis will test whether financial literacy is associated with a longer delay in the date at which an individual claims his/her Social Security benefits after becoming eligible.

> *Hypothesis 1:* The more financially literate will delay claiming their benefits for a longer period of time after becoming eligible for Social Security.

Asset Allocation within Household Portfolios

A second important source of income in retirement comes from the financial wealth a household accumulates prior to old age. A household's financial portfolio typically consists of personal savings (any amount in a savings, checking, certificate of deposit, or a money market account), retirement savings (IRA's, defined contribution plans, defined benefit plans), and any investment in stocks or bonds. Using data from the 2007 Survey of Consumer Finances, Bucks, Kennickell, Mach, and Moore (2009) found that financial assets represented roughly 34 percent of a household's total assets. Their estimates indicate that among those households approaching retirement age, the median value of financial assets

totaled $72,000. The analysis by Bricker, Bucks, Kennickell, Mach, and Moore (2011) suggest that the specific values from Bucks et al. (2009) may have declined since the onset of the recent recession but the importance of these assets to the financial security of a household in retirement remains. Thus, it is important that households competently manage their assets over their lifetimes.

One of the most important ways in which a household can insure themselves against substantial losses is to diversify the assets within their financial portfolio. The Securities and Exchange Commission website defines diversification as the practice of spreading of money among different investments to reduce risk, limit losses and reduce the fluctuations of investment returns.[26] They explain that a portfolio should be diversified both between asset categories (stocks and bonds) and within asset categories (different types of stocks and bonds). A related concept is that of "time diversification" and it refers to how investors should "rebalance" their asset mix over time to keep their investment risk in alignment with their investment horizon or age-weight their asset mix. Asset diversification and time diversification are similar concepts with the distinction of a time component. This part of the discussion will focus both on how well diversified individuals are between asset classes (asset diversification) and on whether households appear to align their risk exposure with their investment horizon (time diversification).

As Markowitz (1991) explained, a well-balanced portfolio should provide the investor with "protections and opportunities with respect to a wide range of contingencies." Asset diversification maintains that individuals should invest in a mix of assets whose performances are uncorrelated or inversely correlated with one another. For instance, the performance of stocks and bonds are thought to be inversely correlated or at least

[26] http://www.sec.gov/investor/pubs/assetallocation.htm

uncorrelated with one another. When stocks are performing well, the demand for bonds is typically low and vice versa. Owning both types of assets allows a household to protect against substantial losses under various market conditions. Time diversification, on the other hand, is predicated on the assumption that stocks are less risky over longer investment horizons. Younger workers have more years or decades to wait out economic contractions and market volatility, so they may benefit from riskier, more volatile investments in a portfolio more heavily weighted towards stocks and stock funds. Conversely, those that are retired or near-retirement ages have relatively less time remaining in the labor market, lower human capital, and shorter life expectancies and therefore, should transition out of stocks and stock funds towards more conservative assets such as bonds and money market funds as they approach retirement. Maintaining an adequately diversified portfolio over time will require that households frequently, or even occasionally, "rebalance" their portfolios when their asset allocation becomes out of alignment with the household investment horizon.

Theoretical models developed in the literature on portfolio choice over the life cycle, support the popular advice that it is optimal for the fraction of an individual's portfolio invested in equities to fall with age (Horneff, Maurer, Mitchell, and Stamos 2008). Researchers in this field have found that individuals lacking a bequest motive would maximize their welfare by putting most or all of their assets into less risky annuities upon retirement (Yaari 1965; Davidoff, Brown, and Diamond 2005).[27] These studies found that through annuitization, consumers could increase their lifetime consumption and insure them against negative shocks to their wealth and longevity risk—the risk of outliving their assets.

[27] Annuities are not entirely risk-free as inflation can erode the value of a fixed payment over time. Many of the studies in this field have added inflation and other factors thought to suppress the demand for annuities only to find that it is still optimal in most cases for most individuals (Brown 2003; Davidoff, Brown, Diamond 2005; Mitchell, Poterba, Warshawsky and Brown 1999). Also, there are annuities available that adjust the benefit amount to account for annual inflation.

However, there is also potential cost associated with in avoiding riskier assets under longer investment horizons as these assets tend to pay a risk premium in the form of higher returns. Retirement plan participants with accounts that do not invest in riskier assets do not capture the higher premium paid on those risky assets and could, therefore, lower their lifetime income. It is up to the individual to balance the need for higher income through the risk premium in their younger years through more exposure to the stock market and riskier assets with the need for income security and insurance against negative shocks to asset prices with their age and a shorter investment horizon. One way to accomplish this is to calibrate the distribution of risky and risk-free assets within their portfolio as they age, otherwise known as time diversification.

While financial experts and investment advisors suggest that individuals decrease their exposure to the stock market as they age, there is no universal standard by which individuals should time diversify their investments between asset classes. The rule of thumb is that the a percentage of an individual's investments held bonds and other less risky assets should equal one's age, but as life expectancies differ between individuals so too will individual investment horizons (Ameriks and Zeldas 2004; Agnew, Balduzzi, and Sunden 2003). Thus, for most, this principle serves more too approximate rather than dictate the level of diversification in a particular portfolio.

At first glance, the empirical evidence on the investment patterns of households is, for the most part, consistent with the expectations of these models and the advice of investment professionals. Studies relying on cross-sectional data indicate a negative relationship between age and the share of their wealth held in stocks (Bodie and Crane 2000; VanDehei, Holden and Alonso 2009). Others have found evidence of a non-linear, hump-shape relationship

between age and equity share, where households increase the equity share of their portfolio during their working lives and then, upon reaching retirement age, move towards safer assets (Yoo 1994; Heaton and Lucas 2000; Agnew, Balduzzi and Sunden 2003). These authors were drawing these conclusions from equity share means estimated from cross-sectional data for each age within a particular year. This method of estimation discounts the possibility of unaccounted for heterogeneity between different age cohorts with respect to the propensity to own stocks and to invest heavily in them. (Ameriks and Zeldas 2004). The decision of younger individuals to hold more equities may be less a function of age than of cohort-specific preferences or circumstances. For example, younger cohorts may be more affected by the transition from defined benefit to defined contribution plans and therefore may be more likely to use the stock market as a vehicle to save for retirement or older generations may be less inclined to invest the stock market after having lived through the Great Depression.

Ameriks and Zeldas (2004) attempt to account for the possibility of cohort heterogeneity by analyzing the relationship between age and asset allocation using panel data from a large financial services provider. They suggest that declines in the equity share of individual financial portfolios over time, which were found in previous studies, are explained by the declining likelihood that an individual owns any stock as they age. They found that, conditional on stock ownership, individuals actually increased the equity share within their portfolios over time regardless of age. They explained that the observed increase was likely due to an overall rise in stock values coupled with inactive portfolio management on the part of households. Their results indicate that individuals are likely to exit the stock market entirely, but among those not exiting, there is no reduction in the equity share of their

portfolio. These findings indicate that stock market exit rather than portfolio equity share is a function of age and that equity share is, instead, a function of market conditions and passive portfolio management.

Looking specifically at the assets within defined contribution plans, Yamaguchi, Mitchell, Mottola, and Utkus (2007) found that only about 10 percent of plan participants either actively or passively rebalance their assets. Those that actively rebalance their accounts personally recalibrate the equity exposure of their portfolio and those that passively rebalance their account rely on "lifecycle funds" that automatically adjust their equity exposure downward as the investor ages. Yamaguchi et al. (2007) found that those that passively rebalance their accounts through age-adjusted lifecycle funds earned the highest risk-adjusted returns. Lifecycle funds operate on the principle implied by time diversification, automatically decreasing the investor's exposure to risky assets, such as equities, as they age and their findings imply that investors stand to gain from time diversifying their assets.

While investors appear to gain from holding diversified portfolios—time, asset, or otherwise—the evidence indicates that investors typically hold under-diversified financial portfolios. Individuals have been shown to favor single asset classes, many investing all of their pensions in either stocks or bonds (Agnew, Balduzzi and Suden 2003). The same behavior is evident within asset classes as many investors often hold only a single mutual fund or concentrate all of their assets in the stock of only a handful of companies (Barber and Odean 2000; Polkovnichenko 2005; Goetzmann and Kumar 2008). Often times, these companies are limited to those located within the same country or region in which investor lives (French and Poterba 1991; Huberman 2001). Others hold large amounts of their

employer's stock in their pension funds creating a potentially dangerous positive correlation between their pension fund and their job security (Benartzi 2001; Mitchell and Utkus 2002). Even among those attempting to diversify their portfolios, many do so "naively", often by simply spreading their assets evenly among the available investment options or among a small group of investments (Benartzi and Thaler 2001; Huberman and Jiang 2006).

Financial Literacy, Asset Allocation and Time Diversification

The lack of time diversification and rebalancing may be due to a lack of investment knowledge whereby individuals do not know the appropriate actions to take in order to implement a coherent diversification investment strategy. Under-diversification may also be the result of a behavioral predisposition towards passive decision-making. While the pathways are not entirely clear, being financially literate may provide individuals with a familiarity with basic concepts investment concepts as well as the confidence to implement them. It may also help suppress the compulsion towards investment-related behavioral biases. While this analysis cannot disentangle the two effects, to the extent that it exists, this study will attempt to measure the total effect of financial literacy on the level of time diversification within individual portfolios.

Hypothesis 2: The more financially literate will be more likely to hold a time diversified, or age-weighted, portfolio.

Inertia within Defined Contribution plans

For most households, retirement assets represent the largest component of their financial asset portfolio (Bricker, Bucks, Kennickell, Mach, and Moore (2011). Most pension assets are invested in defined contribution plans which have supplanted defined benefit plans as the predominant form of private pension offered by employers. Almost 78 percent of those

currently employed and covered by a pension plan are enrolled in a defined contribution plan rather than a defined benefit plan (Department of Labor 2010). Those enrolled in defined contribution plans are responsible for making all the decisions affecting investments in their pension account over time, such as how much to invest and how their funds are distributed within and between different asset classes. This marks an important departure from the once dominant defined benefit plans that were administered by the employer, who also assumed all the investment risk associated with the assets in the firm's plan. Investment decisions are complicated and they are increasingly being made by workers under defined contribution plans rather than professionals that were frequently hired by employers to manage their defined-benefit pension assets (Gale, Papek, and VanDerhei 2005). For most workers covered by defined contribution plans, their investment decisions are critical for establishing their financial security in retirement. Individuals who are not confident in their ability to make wise investment decisions may avoid them completely. If workers are to be responsible for managing their retirement assets, policy makers should understand how financial knowledge interacts with those decisions and if the financially literate are making more informed choices.

Passivity, or inertia, is a behavioral pattern that figures prominently among those displayed by pension holders and is a likely explanation for the lack of diversification and rebalancing over time. Prior analyses of panel data collected from individual investors indicate that large majorities of pension holders make little or no change to their portfolios over time (Ameriks and Zeldas 2004; Calvet, Campbell and Sodini 2009; Brunnermeier and Nagel 2008; Yamaguichi, Mitchell, Mottola, and Utkus 2007; Agnew, Balduzzi and Suden 2003). Researchers explain that this is the result of individuals' tendency towards

procrastination, the "path of least resistance" and an absence of well-defined preferences with respect to their pension management responsibilities (Choi, Laibson, Madrian and Metrick 2002; Madrian and Shea 2001; Thaler and Benartzi 2004; Benartzi and Thaler 2007). These behavioral responses or adaptations to the administration of their assets within their pension portfolios suggests that many, if not most, fail to realign and rebalance the equity share within their pension portfolios with their investment horizon over time.

Inertia within Defined Contribution plans and Financial Literacy

One might expect that the financially literate would recognize the importance of periodically changing the asset distribution within their pension portfolio as well as have the confidence to do so. In other words, the costs associated with financial decision-making are presumed to be lower for those individuals that are more financially literate. This could explain the inertia evident among those with defined contribution plans. As Yamaguichi, Mitchell, Mottola, and Utkus (2007) state, it is "important to determine whether this inertia is driven by financial illiteracy."

> *Hypothesis 3*: Those that are less financially literate will be less likely to have ever changed the asset allocation within their defined contribution plan.

Data and Variables

Data

This analysis will rely on data collected in the Health and Retirement Study (HRS), a nationally representative survey of U.S. residents born in 1953 or earlier. Data collection for this panel dataset began in 1992 and has been augmented since then with additional cohorts of the aged from the 48 contiguous states. The longitudinal survey design of the HRS allows

researchers to follow older cohorts as they make the transition from work into retirement. Every two years the HRS compiles information on the demographics, health, social, and economic factors from the more than 20,000 elderly individuals it follows. The survey provides detailed financial data including pension information as well as information on the timing of Social Security claiming decisions. Each wave of the HRS also contains an experimental module that is administered to a random subsample of the respondents covering a variety of different aging related material. Included in the experimental module of the 2008 wave was a battery of questions aimed at measuring the extent to which the respondent understood financial and investment related concepts.

Sample

The financial literacy questions in the experimental module were administered to a random subsample of 1,474 respondents in the 2008 wave. Those respondents that participated in the experimental survey were then randomly assigned to two separate groups at the beginning of the survey. For the purposes of this analysis these groups will be referred to as Group A and Group B. Respondents in each group were asked the same questions, however, the question wording throughout the financial and investment-related questions were different for each group. For example, Group A was asked whether the following statement that was true or false: *if the interest rate falls, bond prices will rise*. Alternatively, Group B was asked to make the same determination using the following statement: *if the interest rate falls, bond prices will fall*.

Responses to questions from this wave will be used to construct the variables the defined financial literacy index in this analysis. The outcomes and control variables will be constructed from data provided by respondents in the other sections of the core survey.

The data from 1,474 respondents are used in this study. However, the sample size varies depending on the outcome and dependent variable measures employed in each of the separate regressions. The variation in the sample sizes is largely due to the restrictions that the outcome variables place on the individuals that eligible to be included in the analysis. For example, one outcome looks at the timing of an individual's claiming decision for Social Security. Therefore, only those individuals that have actually claimed their Social Security benefits are included in the regression model for this outcome. The additional restrictions that each outcome requires for the individual to be included in the estimation sample are detailed below along with the outcome specific sample sizes.

Dependent Variables

Timing of Claiming Decision (DFRA)

The outcome variable in this analysis, *DFRA*, measures the difference in months between when an individual reaches their Full Retirement Age (FRA) and when they decide to claim their Social Security benefits. To construct this variable, individuals were first assigned their respective FRA as measured in months. The FRA for an individual born in 1945 is age 66 so each person born in this year was assigned a value of 792 to represent their FRA as expressed terms of the number of months they would have to live to obtain their full Social Security benefit (66 years x 12 months = 792 months). Then the actual age in which the individual claimed their benefits (also expressed in terms of months) was subtracted from their FRA to obtain the difference, if any, in the number of months that an individual claimed their benefits before or after their FRA. If the same individual born in 1945 in the previous example were to claim his Social Security benefit 3 months after turning 63, then he would

have claimed his benefit after living 759 months, 33 months before he was eligible for his full benefit and would be assigned a value of -33 (752 - 792 = -33).

This dependent variable narrows the estimation sample included in this portion of the study because the measure is only observed for those individuals that are currently receiving Social Security. The operationalization of this variable would not capture those individuals that were currently eligible for benefits but not yet receiving them. This might bias the estimate of the coefficient on the financial literacy variable downward if these individuals are also more financially literate. There were 71 individuals that were eligible for Social Security but had not yet claimed their benefits. Finally, the sample was further restricted to those individuals that had applied for Social Security benefits after the minimum eligible age of 62. This step was taken to ensure that the sample did not include those individuals that applied for benefits due to a disability. The inclusion of these individuals may have otherwise resulted in an upwardly biased estimate on the coefficient for financial literacy because those that reported ever receiving disability have lower financial literacy scores than those who had not. After the restrictions were applied, this outcome was observed for 464 individuals.

The summary statistics for this measure are provided in Table 4. These estimates indicate that most individuals claim their benefits prior to their FRA. On average, individuals claim their Social Security benefits 22.6 months prior to their FRA.

Distance Between Recommended and Actual Asset Mix (DIST)

The second dependent variable is a continuous measure of the difference between the recommended and actual distribution of a household's financial assets between stocks and other, less risky, investment vehicles (Treasury bills, bonds, savings accounts, and money market funds). For simplicity, the non-stock investments will be referred to collectively as

"bonds." To estimate this difference, the age of the respondent is first subtracted from 100 (or the average age of the respondent and spouse if the respondent is married) to arrive at the recommended level of stock market exposure (RAM). The RAM is then subtracted from the actual share of respondent's portfolio invested in stocks (AAM). Finally, the absolute value of this difference is taken to create a non-negative measure that approximates how close or how far an individual's portfolio is from their recommended asset mix given their age (DIST).

$$RAM = 100 - Age$$

$$DIST = |\, AAM - RAM \,|$$

This DIST variable has higher values for those individuals with portfolios that are further away from their recommended asset mix, increasing by one for each percentage point above or below the recommend amount with 0 representing a "balanced" portfolio. The absolute value of the difference is taken because equal weight is given to portfolios that are too conservative and too risky. For example, an individual aged 65 with 90 percent of his financial assets in stocks rather than bonds would have a value of 55 (100 - 65 = 35 and |90 - 35| = 55). If this same individual were instead to have 90 percent of their portfolio invested in bonds and 10 percent in stocks then he would have a value of 25 for this measure (100 - 65 = 35 and |10 – 35| = 25). This measure is used in an ordinary least squares regression model.

While the construction of this measure is based on the "100 – Age = Stock Share" rule-of-thumb, this study does not mean to imply that this is the only correct distribution (Ameriks and Zeldas 2004; Agnew, Balduzzi, and Sunden 2003).[28] Portfolio distributions are a function of a number of different determinants that one can attempt to control for including

[28] This advice can be found on many popular financial media outlets such as the popular, Get Rich Slowly blog, but without attribution. For example: http://www.getrichslowly.org/blog/2009/03/09/25-favorite-financial-rules-of-thumb/.

life expectancy, risk aversion, and investment horizons as well as other less quantifiable factors that affect this decision. This measure is intended to be a useful, albeit imperfect, heuristic for analyzing the time component of portfolio risk as it relates to age and diversification across asset classes. It will be used to determine whether or the extent to which the more financially literate are more likely to have distributions that more closely resemble their recommended allocations.

The mean value from Table 4 indicates that, on average, individuals are 41 percentage points away from the recommended asset mix in their portfolios. This outcome was observed for only those individuals with financial assets, 577 individuals

Portfolio Inertia

The third variable is intended to capture portfolio inertia over time.[29] It was constructed from the HRS survey question that asked respondents whether they had ever changed the asset allocation within their defined contribution plan. Responses to this question were used to create a dichotomous measure that is coded 1 for those individuals that reported having ever changed their allocations and 0 for those that had said they had never done so. The buying or selling of stocks, bonds or any funds outside of any defined contribution pension plan including anything held within an IRA or Keogh account, would not be captured by this measure. This measure was observed for the subsample of individuals that reported to having a defined contribution plan in the 2004 or 2006 wave of the HRS, a total of 256 respondents.[30]

[29] While only one wave of data are used. The question in this wave asks the respondent has *ever* changed their pension allocation, which captures activity in the past, over the life of the pension.
[30] The question asked those with defined contribution plans whether they had ever changed the allocation of assets within their plan. It was asked only in the 2004 and 2006 wave of the HRS.

This measure is essentially a proxy for how engaged an individual is in the investment decisions related to their defined contribution pension, but it does not evaluate the extent to which these decisions are in the best interest of the individual (e.g. making it more diversified across time, across asset classes, or within a particular asset class). Despite this limitation, the portfolio inertia variable will be useful in determining whether pension activity is associated with financial literacy. That so many individuals fail to ever change the allocations within their plan raises important questions regarding their ability to administer these plans on their own behalf. It is important to determine whether financial literacy may play a positive role in helping engage individuals in these decisions.

The mean value from Table 4 indicates that only 50 percent of those with a defined contribution plan have ever changed the allocation within their plan.

Independent Variables

Financial Literacy. The key explanatory variable is an index aimed at measuring financial literacy. This index is constructed from responses to financial and investment related questions within the experimental module of the 2008 wave of the HRS. Only those survey questions in which an objectively correct or incorrect response can be given are used to construct this index, excluding those aimed as measuring the respondent's attitudes regarding financial matters. The questions used to construct this index are common among those studies attempting to measure financial literacy (Lusardi and Mitchell 2009; Lusardi and Mitchell 2007). Scores on the financial literacy index are based on the number of correct responses to the following seven financial and investment-related questions:

1. Few versus Many
    a. Group A: You should invest most of your money in a few good stocks that you select rather than in lots of stocks or in mutual funds. [T or F]

    b. Group B: You should invest in either mutual funds or a large number of different stocks instead of just a few stocks. [T or F]
2. Risk and Diversification
    a. Group A: When an investor spreads money between 20 stocks, rather than 2, the risk of losing a lot of money decreases. [T or F]
    b. Group B: When an investor spreads money between 20 stocks, rather than 2, the risk of losing a lot of money decreases. [T or F]
3. International Stocks
    a. Group A: It is best to avoid owning stocks of foreign companies. [T or F]
    b. Group B: It is a good idea to own stocks of foreign companies. [T or F]
4. Company Stock
    a. Group A: An employee of a company with publicly traded stock should have a lot of his or her retirement savings in the company's stock. [T or F]
    b. Group B: An employee of a company with publicly traded stock should have little or none of his or her retirement savings in the company's stock. [T or F]
5. Bonds and Interest Rates
    a. Group A: If the interest rate falls, bond prices will rise. [T or F]
    b. Group B: If the interest rate falls, bond prices will fall. [T or F]
6. Interest Rates
    a. Group A: If you start out with $1,000 and earn an average return of 10% per year for 30 years, after compounding, the initial $1,000 will have grown to more than $6,000. [T or F]
    b. Group B: If you start out with $1,000 and earn an average return of 10% per year for 30 years, after compounding, the initial $1,000 will have grown to less than $6,000. [T or F]
7. Credit Card
    a. Using money in a bank savings account to pay off credit card debt is usually a good idea. [T or F]
    b. Using money in a bank savings account to pay off credit card debt is usually a bad idea. [T or F]

The maximum possible score is 7 (indicating 7 correct responses) and the lowest possible score is 0 (indicating no correct responses). The mean score for the index was 3.2 indicating that, on average, the sample was able to provide a correct response to less than half of the questions. Other studies have also used an additive index, such as this, to operationalize financial literacy in their models (Brown, Kapteyn, and Mitchell 2011). The measure of internal consistency for this index (Cronbach's alpha) was .52; lower than the conventional standard of .70. Multiple iterations of the index were tried to increase the

internal consistency of this index, but each resulted in lower measures. For an overview of why the Cronbach's alpha measure is lower than the conventional standard of internal consistency see the discussion of measurement error in the Appendix.

Control Variables

Controls Common to Each Model. This analysis relies on a common set of demographic control variables used in the models for each outcome. These variables are listed in Table 4 and include a continuous measure of the respondents' age and dichotomous measures indicating the respondent's sex, race, marital status and educational attainment. Each model also includes a dummy variable coded 1 if the respondent reported being in excellent/very good/good or 0 if in poor/very poor health. A dummy variable indicating the respondents' financial planning horizon is coded 1 for those individuals reporting to that their planning horizon is longer than 10 years, 5-10 years, or the next few years and 0 for those reporting planning horizons that only include the next few months or to next year. The models also include a measure of the respondent's self-reported life expectancy. Those respondents that were younger than 75 when the HRS survey began were asked about their probability (0 -100) of living until age 75 and this continuous measure was included in the model to control for the effect of subjective life expectancy on, say, the timing of one's claiming decision.[31] The logged value of the estimate of the present value of a households

[31] In the HRS, respondents are asked to provide their projections for their life expectancy in terms of the likelihood that they would survive to 75. It is important to control for an individual's subjective expectations for life expectancy, using, preferably, those expectations just before they, say, claimed their Social Security benefits. Where possible, these measures were replaced with the values from the wave prior to the individuals claiming decision for the regression analyzing the timing of the individual's Social Security decision. More details are provided on these adjustments in the following section. This is an important adjustment because, if people are incorporating their life expectancy into their claiming decision, it is important to know what their subjective expectations were when they could first make their decision rather than measure the affect of, say, current health status. The most recent measures provide no sense of the circumstances faced by the individual at the time of their claiming decision; therefore, many of the measures were adjusted for this portion of the analysis to reflect the measure of the variable just before they claimed their benefits. Where this was not

defined benefit at age 65 is also included to control for the possibility that this type of wealth would influence claiming and investment decisions.[32] Finally, log-transformed measures of household income and wealth were included in the models.

Regression Specific Controls. Each model includes control variables specific to the outcomes analyzed in each model. The model analyzing the relationship between financial literacy and the timing of the individuals' claiming decision includes a dummy variable indicating whether the individual has a health condition that limits their ability to work. Presumably, those with work-limiting health conditions may be compelled to claim their benefits prior to their FRA out of necessity and it was important to control for this possibility. This variable is composed of responses from the most recent wave prior to the respondent's decision to claim their benefits.[33] A dummy variable indicating whether the respondent has worked in any year since receiving Social Security is included to control for the possibility that those that want or need to work in retirement are distinct from those that do not. The income variable in this model was reconfigured to represent the income of the household prior to claiming decision as was the total household wealth measure. Finally, the number of children that the respondent reports having was included to stand as a proxy for the ability of the respondent to rely on family in retirement.

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available, data were used from the wave closest to that decision to try to capture their life expectancy at the closest point around their claiming decision. The following section provides more information on which variables were affected by these adjustments.

[32] The data from this measure came from the 1992, 1998 and 2004 waves of the HRS. An attempt was made to procure the Social Security data from the HRS but a lack of a secure computer to house this information precluded my eligibility to obtain this data.

[33] Again, this step was taken because an individual's current condition may not reflect their condition prior to their claiming decision and this measure is intended to control for the effect of a work limiting condition on the timing of an individual's claiming decision. For example, a 70 year-old respondent may have a work limiting condition in 2008, but did not suffer from that condition prior to their claiming decision in which case, this condition would not have affected their decision to claim early.

In addition to the set of common control variables, the second and third models analyzing the age-adjusted distribution of investments by asset classes includes dummy variables that are intended to measure risk aversion. The risk aversion measure is constructed from question in the HRS that presents respondents with a hypothetical choice between a current job and a new one that has varying likelihoods of either increasing or reducing the level of income they receive from their current job.[34] There are three risk aversion dummy variables included in the model. Those that opted to take the second, more risky, job situation at each stage of the question were coded 1 for the dummy variable indicating the least risk averse; those that took the second job in the first stage of the scenario and the first job in the second were coded 1 for the dummy variable indicating that they were third most risk averse; those that took the fist job in the first stage of the scenario and the second job in the second were coded 1 for the dummy variable indicating that they were second most risk averse; those that took the first job at each stage of the question were coded 1 for the dummy variable indicating the most risk averse. The risk aversion variable is intended to control for the fact that individuals may have a more robust appetite for risk and therefore desire to carry more stocks in their portfolio regardless of their age, or conversely those with more risk aversion would hold more bonds. A second control is included that measures the likelihood that the respondent will leave an inheritance of $10,000 or more. To control for the possibility that the knowledge that one intends to leave an inheritance would result in an

[34] The question is a series of unfolding questions. Whether or not the individual proceeds to next portion of the question depends on their responses. For the full sequence, see the Appendix. The first stage of risk aversion measure is derived from the following question: "Suppose that you are the only income earner in the family. Your doctor recommends that you move because of allergies, and you have to choose between two possible jobs. The first would guarantee your current total family income for life. The second is possibly better paying, but the income is also less certain. There is a 50-50 chance the second job would double your total lifetime income and a 50-50 chance that it would cut it by a third. Which job would you take -- the first job or the second job?"

outward adjust in the individual's investment horizon. A longer investment horizon would call for an increase in the share of stocks in their portfolio.

There are no control variables specific to analysis of portfolio inertia. Consideration was given to the inclusion of a variable measuring the mix of stocks versus bonds within the individual portfolio. However, the direction of causality in this relationship is not clear and likely endogenous. While it is possible that the asset mix can predict pension activity, the findings from Ameriks and Zeldas (2004) indicate that relationship likely runs in the other direction. They find that passivity results in a higher concentration in the asset that has gained the most in relative value which indicates that portfolio inertia can actually determine the asset mix within the portfolio rather than the other way around.

Methods

This analysis will attempt to measure the association between financial literacy and each of the outcomes identified using multiple regression techniques. Ordinary least squares regression is used to analyze the Social Security claiming (*DFRA)* and optimal asset mix (*DIST)* outcomes and logistic regression is used to analyze the variable indicating portfolio inertia.[35] Two models are estimated for portfolio inertia; one that includes wealth in defined

[35] The timing of the claiming decision was also modeled using a Cox proportional hazards model to analyze the timing of the claiming decision after individuals became eligible for benefits at age 62. Cox regression is an event history analysis technique that is used to estimate the hazard rate which, in this analysis, is defined as the conditional probability that an individual will claim their Social Security benefits at time *t* given that he/she has not already applied for his/her benefits. The initial time period ($t_i = 0$) for each individual in the sample is defined as the month that they became eligible for Social Security, the month of their 62nd birthday. Individuals remain in the sample until they have claimed their benefits in time period t_i. Because the claiming decision is not observed for those individuals that had not yet claimed their benefits, the data were right censored. There is nothing that can be done about right censoring except collect at later time periods. Due to the survey design of the HRS and the lack of detailed information on exact timing of specific changes in the factors that likely effect claiming behavior the variables in the model were time invariant. This analysis controlled for the same covariates as the analysis of the DFA outcome. Here again, financial literacy was not found to be associated with the timing of the claiming decision. However, this analysis could be expanded to incorporate some of the health shocks that may affect the timing of a claiming decision such as the month and year that an individual experienced a heart attack. This is an analysis to be replicated in a subsequent study but will not likely focus on financial literacy.

contribution plans and another substitutes this measure for total household wealth minus defined contribution plan wealth. It is possible that the amount of wealth in a defined contribution plan will determine whether an individual will take the time to manage those assets—individuals may not bother managing low account balances. However, it is also possible that defined contribution wealth is determined by the activity of the individual. To account for possible simultaneity between inertia and defined contribution wealth, two specifications were necessary; one that assumes it does not amount and another that assumes it does.

It is important to note that the aim of this study is not to measure the causal effect of financial literacy on the outcomes analyzed. While a causal analysis would be preferable, the observational data from this module does not lend itself to quasi-experimental techniques. However, there is value in establishing whether optimal financial behaviors are correlated with financial literacy. The findings from basic regression analyses can serve as the basis for future causal studies by focusing the attention of researchers on those outcomes thought to be affected by financial literacy. Though, for this study, the lack of a causal framework requires that any significant relationships between financial literacy and the outcome variables be interpreted carefully and with the acknowledgment that at least some of the measured effect is likely confounded by unobserved heterogeneity in the data.

Results

The results from the regression models for each outcome are reported in Table 5. Model 1 estimates the relationship between financial literacy and the timing of individual claiming decisions. The coefficient (.37) on the literacy index variable indicates that the correlation between financial literacy and the timing of individual Social Security claiming

decisions is not significantly different from zero. That is, financial literacy, as defined in this analysis, does not appear to be an important determinant for whether an individual's delay in claiming their Social Security benefits beyond 62, the minimum age of eligibility.

The significant results generally move in the expected direction. College graduates appear to delay their claiming decision by 4 months on average.[36] A one percent change in income at age 62 is associated with a delay of 2 months in the claiming decision implying that those with high incomes are less likely claim their benefits. Those that work while receiving their Social Security benefits also delayed their claiming decision by almost 6.5 months after having turned age 62. The positive coefficient suggests that this may be capturing the variation associated with whether the individual places an intrinsic value on work. Those with higher levels of defined contribution wealth are also more likely to delay their claiming decision. Older individuals also appear more likely to delay their claiming decisions but the age variable is likely capturing the generational differences in claiming behavior. The finding that older individuals appear to have delayed their claiming decision is consistent with the data indicating that younger retirees are claiming their benefits earlier than previous generations (Figure 2). Finally, having a work limiting condition at age 62 appears to result in those individuals claiming Social Security 6 months earlier as does having more children, on average.

The results from Model 2 estimating the relationship between financial literacy and the risky financial asset allocation within household portfolios are displayed in the second column of Table 5. According to the coefficient of the financial literacy variable, the relationship between these two variables moves in the expected direction but is modest in

[36] The correlation coefficient for having a college education and the financial literacy index is .26, indicating that college educated individuals are more likely to be financially literate.

size and significant only at the .10 level. A unit increase in the financial literacy index is associated with a 1 percentage point decrease in the difference between the recommended share of the individual's asset allocated between stocks and bonds given their age and their actual distribution. This result suggests that the financially literacy is only weakly associated with having a portfolio that is in proportion to the assumed investment horizon of the household. The coefficient on the financial literacy variable is small and the statistical significance of this relationship is below conventional standards. In other words, the financially literate are more diversified across the time component of investment risk, but not by much.

With regard to the other explanatory variables, it is encouraging that the group of least risk averse individuals tend to hold a portfolio with a more risky asset allocation given their age. This finding lends support to the claim that the outcome variable in this portion of the analysis is a valid measure of investment risk. However, the financial literacy index and the risk-aversion measure were the only variables that are significantly associated with the outcome. This result may be due to an under-specified model or it may be that investment decisions are inherently noisy and therefore difficult to model.

The third and fourth columns of Table 5 display the results from the logistic regression of the outcome indicating whether an individual has ever changed the asset allocation of their defined contribution plan on the financial literary index and a vector of control variables. The coefficient on the financial literacy index in each model indicates that there is a positive and significant correlation between financial literacy and the likelihood that an individual has ever changed the asset allocation within their defined contribution plan. The strength of this relationship, however, depends on the specification of the model.

The two different models are distinguished by the differences in the wealth variable included in each. The model 3a (column 3) has the log of the wealth within the defined contribution plan and model 3b (column 4) has the log of total wealth. Due to the nature of logistic regression and how unobserved heterogeneity affects the estimates in this type of estimation, it is not possible to compare the coefficients or their statistical significance across the models so each regression model is discussed separately (Hoetker 2007; Mood 2010; Allison 1999). In column 3, higher levels of income, defined contribution wealth, and defined benefit all increase the likelihood that an individual takes an active role in managing their pension. These results allow for two possible interpretations: 1) those with low levels of wealth within their defined contribution plan may not feel compelled to take the time to manage the assets and/or 2) because the wealthy have more assets, they are more comfortable in involving themselves in the decisions that affect them. Being married and having a higher subjective life expectancy each decrease this likelihood. The explanation for this relationship is not entirely clear. In column 4, again, higher levels of defined benefit wealth and total wealth (minus defined benefit wealth) are associated with an increase in the likelihood that an individual has ever taken an active role in managing their account by changing the allocation within their pension plan. Finally, the number of children a person has and their higher subjective life expectancy are each associated with a lower likelihood of actively managing any defined contribution pension balance.

Discussion

The results from this analysis indicate that financial literacy is not associated with Social Security claiming behavior and provides evidence that it is weakly associated with recommended investment behaviors. The only factors that appear to predict the timing of

individuals' claiming decisions suggest that those most likely to enter retirement with the least financial security—the unemployed, those without a college degree, and low wealth households—are the most likely to experience a reduction in their Social Security benefit due to claiming their benefits early. No direct measure of Social Security knowledge was included in the construction of the index used in this analysis and it is possible that are more knowledgeable regarding their benefits may make more informed decisions related to Social Security, but this possibility cannot be established from this analysis. The results suggest that improving financial literacy in one or two areas (investment and estimation) may not have spillover effects for individuals' behavior in other financially-related areas that impact the welfare of individuals and households such as the Social Security. Future research may focus on how direct knowledge of the Social Security rules defining benefit levels, and perhaps how such rules are framed, affects the claiming behavior of program participants.

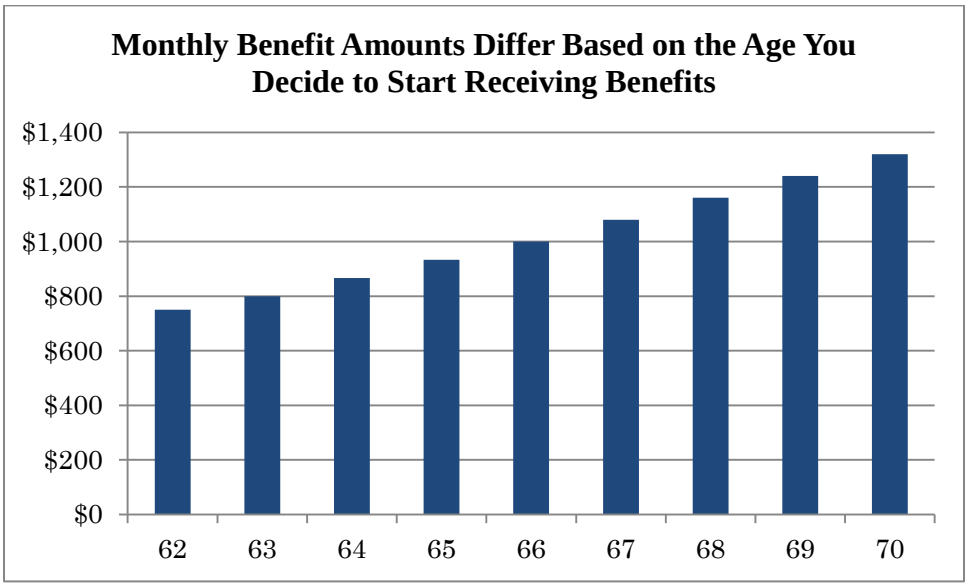
Although the strength of the statistical relationships are weaker than conventional levels of significance and the size strength of this association appears weak, the financially literate appear to hold portfolios that are more "balanced" according to their age, or time diversified, and are more active in managing their account balances. The findings do not provide overwhelming empirical support for the idea that financial literacy will significantly reduce investor risk associated with asset rebalancing over time.

One encouraging finding is that the financially literate appear to be more engaged with their retirement assets by taking an active role in changing the account balances. However, as far as financial management goes, this is little more than the bare minimum. It is not clear that this knowledge leads to substantial reductions in financial risk or better management, just that it is associated with more activity.

Until we know more about whether the financially literate are more capable administrators of their wealth, the short-term solution with respect to this issue may be advocating for default mutual funds or exchange-traded funds that automatically adjust equity and bond exposure based on the age of the investor. The Social Security issue may prove more intractable because increasing knowledge and awareness may be the one of only a handful of possible solutions. Although the sample size in this study was, admittedly, small and the measure for internal consistency of the index fairly weak, financial literacy does not appear to affect this decision. Future research should be aimed at obtaining more reliable data from a large sample and establishing a causal link between financial literacy and financial behaviors.

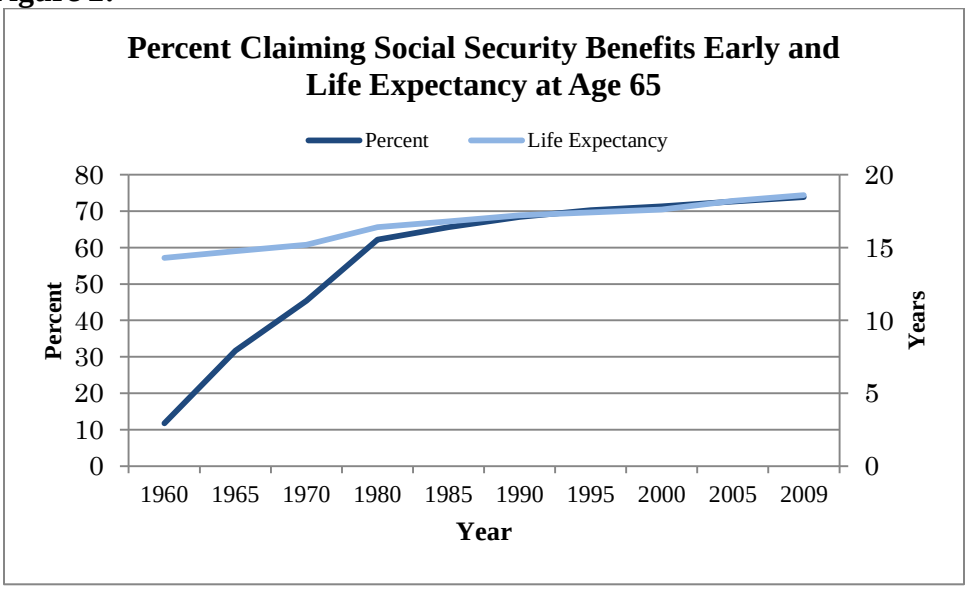
Tables and Figures

Figure 1:



Source: Social Security Administration (2008). "When to Start Receiving Retirement Benefits."

Figure 2:



Source: National Center for Health Statistics (2011). "Health, United States, 2010." Social Security Administration (2011). "Annual Statistical Supplement to the Social Security Bulletin, 2010."

Table 1: Social Security Eligibility: Ages for Full Retirement Benefits, Penalties, and Credits

Year of Birth	Year Individual Turns 62	Full Retirement Age (FRA)	Per Month Reduction If Benefits Began Prior to Full Retirement Age	Age 62 Benefits as % of FRA Benefits	Per Year Delayed Retirement Credits	Age 70 Benefits as a % of FRA Benefits
1936 or prior	1998 or prior	65	5/9%	80%	6%	130%
1937	1999	65	5/9%	80%	6 1/2%	132 1/2%
1938	2000	65 and 2 months	5/9% for 36 months + 5/12%/mo**	79 1/6%	6 1/2%	131 5/12%
1939	2001	65 and 4 months	5/9% for 36 months + 5/12%/mo**	78 1/3%	7%	132 2/3%
1940	2002	65 and 6 months	5/9% for 36 months + 5/12%/mo**	77 1/2%	7%	131 1/2%
1941	2003	65 and 8 months	5/9% for 36 months + 5/12%/mo**	76 2/3%	7 1/2%	132 1/2%
1942	2004	65 and 10 months	5/9% for 36 months + 5/12%/mo**	75 5/6%	7 1/2%	131 1/2%
1943-1954	2005-2016	66	5/9% for 36 months + 5/12%/mo**	75%	8%	132%
1955	2017	66 and 2 months	5/9% for 36 months + 5/12%/mo**	74 1/6%	8%	130 2/3%
1956	2018	66 and 4 months	5/9% for 36 months + 5/12%/mo**	73 1/3%	8%	129 1/3%
1957	2019	66 and 6 months	5/9% for 36 months + 5/12%/mo**	72 1/2%	8%	128%
1958	2020	66 and 8 months	5/9% for 36 months + 5/12%/mo**	71 2/3%	8%	126 2/3%
1959	2021	66 and 10 months	5/9% for 36 months + 5/12%/mo**	70 5/6%	8%	125 1/3%
1960 or later	2022 or later	67	5/9% for 36 months + 5/12%/mo**	70%	8%	124%

Source: Meyer and Reichenstein (2010) and Jennings and Reichenstein (2001). The table and all the data come from Meyer and Reichenstein (2010).

Table 2: Monthly Payoffs from Social Security for a Single Person with Full Retirement Age (FRA) of 66 and Life Expectancy of 22 Years After Reaching Age 62

Age	Years	Claim Social Security at age 62	Claim Social Security at age 66	Claim Social Security at age 70
62	1	$1,500		
63	2	$1,500		
64	3	$1,500		
65	4	$1,500		
66	5	$1,500	$2,000	
67	6	$1,500	$2,000	
68	7	$1,500	$2,000	
69	8	$1,500	$2,000	
70	9	$1,500	$2,000	$2,640
71	10	$1,500	$2,000	$2,640
…	…	…	…	…
83	22	$1,500	$2,000	$2,640
Present Value of Social Security		$308,044	$319,094	$311,311

Source: Meyer and Reichenstein (2010)

Table 3: Monthly Payoffs from Social Security for a Single Person with Full Retirement Age (FRA) of 66 and Life Expectancy of 10 Years After Reaching Age 62

Age	Years	Claim Social Security at age 62	Claim Social Security at age 66	Claim Social Security at age 70
62	1	$1,500		
63	2	$1,500		
64	3	$1,500		
65	4	$1,500		
66	5	$1,500	$2,000	
67	6	$1,500	$2,000	
68	7	$1,500	$2,000	
69	8	$1,500	$2,000	
70	9	$1,500	$2,000	$2,640
71	10	$1,500	$2,000	$2,640
Dies 72				
Present Value of Social Security		$267,294	$121,978	$51,118

Source: Meyer and Reichenstein (2010)

Table 4: Variable Means

	Mean/Percentage
Average Number of Months between Claiming Decision and FRA	-22.6
Distance Between Recommended and Actual Asset Mix	41
Ever Changed their Pension Allocation	0.5
Financial Literacy Index	4.1
College	0.26
Male	0.45
Black	0.11
Married	0.77
Reports Being in Good Health	0.9
Age	66
Number of Children	3.2
Respondent Reports Being a Long-term Financial Planner	0.76
Currently Employed	0.47
Total Household Wealth (Median)	303650
Total DC Wealth (Median)	40000
Total Present Value of DB Wealth (Median)	159705
Total Household Income (Median)	55800
Least Risk Averse	0.13
3rd Most Risk Averse	0.11
2nd Most Risk Averse	0.16
Most Risk Averse	0.6
Probability of Leaving a Bequest of $10K or More	0.79
Probability of Surviving the 10 years	0.55
Work Limiting Health Condition	0.23
Number of Observations	808

Table 5: Regression Results

	Timing of Soc Sec Claim Dec.	Age-Adj. Pen. Alloc.	Ev Chng Pen. Alloc	Ev Chng Pen. Alloc
Financial Literacy Index	**-0.365**	**-1.062***	**0.317***	**0.277*****
	(0.539)	**(0.606)**	**(0.188)**	**(0.098)**
Ln(Income)		-0.965	1.645***	-0.150
		(0.919)	(0.614)	(0.121)
Ln(Income at 62)	1.949***			
	(0.705)			
College	4.121*	1.379	0.722	0.404
	(2.280)	(2.077)	(0.637)	(0.340)
Black	0.900	-0.624	0.016	-0.187
	(1.774)	(1.927)	(0.594)	(0.315)
Married	0.622	-0.117	-3.026**	-0.635
	(2.873)	(3.637)	(1.322)	(0.497)
In Good Health	-3.074	0.076	-1.135	0.141
	(2.132)	(2.601)	(0.988)	(0.413)
Age	-4.589	-1.771	0.575	-0.440
	(3.191)	(3.574)	(0.915)	(0.475)
Age Squared	18.554**	-0.863	0.980	0.772**
	(7.591)	(1.626)	(0.704)	(0.362)
Number of Children	-0.122**	0.011	-0.008	-0.006**
	(0.054)	(0.013)	(0.006)	(0.003)
Male	0.469	-0.559	0.087	-0.035
	(0.390)	(0.523)	(0.148)	(0.090)
Long-term Finan. Planner	1.311	0.199	0.035	0.184
	(1.893)	(2.358)	(0.811)	(0.380)
Log(DB Wealth)	0.251	0.069	0.095*	0.077***
	(0.157)	(0.158)	(0.049)	(0.025)
Currently Working		2.418	2.052	0.116
		(2.144)	(1.538)	(0.459)
Ln(Total Wealth)		0.174		0.295**
		(0.891)		(0.125)
Pr(Surviving Next 10 Yrs)		0.024	-0.026**	-0.011*
		(0.033)	(0.012)	(0.005)
Least Risk Averse		6.177**	-1.453	0.450
		(2.933)	(1.086)	(0.566)
3rd Most Risk Averse		-1.264	2.409*	0.110
		(2.821)	(1.405)	(0.499)
2nd Most Risk Averse		-0.077	0.512	-0.039
		(2.502)	(0.613)	(0.358)
Pr(Leave Bequest >10K)		-0.014	0.003	0.006
		(0.037)	(0.010)	(0.005)
Log(Total DC Wealth)	1.949***		0.306**	
	(0.705)		(0.131)	
Pr(Surviving to 75)	-0.032			
	(0.031)			
Work Lim. Hlth Cond.	-6.105**			
	(2.804)			
Ever Worked in Retirement	6.544***			
	(1.711)			
Log(Wealth at 62)	0.190			
	(0.560)			

Constant	-743.469***	62.276	-54.286**	-26.168**
	(267.866)	(52.441)	(23.104)	(11.061)
Observations	464	577	126	256

Appendix

Measurement Error and Cronbach's Alpha

Cronbach's Alpha is a measure of internal consistency that indicates how closely a group of items are related. This measure is used to provide evidence that multiple items in an index are measuring the same construct and is often referred to as the reliability coefficient. In this analysis, this measure is used to measure how well the components of the financial literacy index measure financial literacy. A reliability coefficient of .70 or higher is considered standard in social science research. The reliability coefficient in this study is lower than conventional standards and this is likely to due to measurement error in the data related to the financial literacy questions in the HRS.

Those respondents that participated in the experimental survey were randomly assigned to two separate groups at the beginning of the survey. For the purposes of this analysis these groups will be referred to as Group A and Group B. Respondents in each group were asked the same questions, however, the question wording throughout the financial and investment-related questions were different for each group. For example, Group A was asked whether the statement that was true or false: *if the interest rate falls, bond prices will rise*. Alternatively, Group B was asked to make the same determination using the following statement: *if the interest rate falls, bond prices will fall*. While alternative wording of the questions were intended to determine the respondents' knowledge of the same concept, the rate of correct responses frequently depended on how the financial literacy questions were worded in this module (Lusardi, Mitchell, and Curto 2009) These differences represent the extent of measurement error in responses provided that could be the result of either respondents not understanding the question or, more likely, in the form of guessing. Measurement error resulting from responses sensitive to question wording is not specific to the HRS but is commonly thought to exist among surveys measuring financial literacy (Lusardi and Mitchell 2007; Lusardi and Mitchell 2009; van Rooij, Lusardi and Alessie 2007). The measurement error in these responses would lower the reliability coefficient for the financial literacy index.

Risk Aversion

Suppose that you are the only income earner in the family. Your doctor recommends that you move because of allergies, and you have to choose between two possible jobs. The first would guarantee your current total family income for life. The second is possibly better paying, but the income is also less certain. There is a 50-50 chance the second job would double your total lifetime income and a 50-50 chance that it would cut it by a third. Which job would you take -- the first job or the second job?

If first job is chosen in the first question, then: Suppose the chances were 50-50 that the second job would double your lifetime income and 50-50 that it would cut it by twenty percent. Would you take the first job or the second job?

If first job is chosen in the second question again, then: Suppose the chances were 50-50 that the second job would double your lifetime income and 50-50 that it would cut it by 10 percent. Would you take the first job or the second job?

If second job is chosen in the first question, then: Suppose the chances were 50-50 that the second job would double your lifetime income, and 50-50 that it would cut it in half. Would you take the first job or the second job?

If second job is chosen in the second question again, then: Suppose the chances were 50-50 that the second job would double your lifetime income and 50-50 that it would cut it by seventy-five percent. Would you take the first job or the second job?

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