The Employment of Older Workers

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THE EMPLOYMENT OF OLDER WORKERS

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ABSTRACT

This thesis focuses on the employment of older workers and addresses the following questions: how people make their retirement decision, how changes in the Social Security benefit rules can encourage older workers to stay in the labor force longer, and what impediments older workers face on the labor market that can prevent them from working longer and interrupt their retirement plans. As the U.S. population ages, retirement and Social Security claiming decisions of older workers will have a significant impact on the U.S. economy. By the year of 2030 about 20 percent of the population will be 65 years old or older. The national retirement system generates less income in retirement than it did in the past. Rising Full Retirement Age, the shift of the private pension system from predominantly defined benefit to predominantly defined contribution pension plans, and increasing longevity will have to force older workers to stay in the labor force in the future to provide adequate income in retirement.

Chapter one presents a dynamic stochastic retirement model that incorporates observed heterogeneity in educational attainment level. The assumption is that educational attainment level is highly correlated with the characteristics, such as preferences for work, types of jobs, and financial planning horizon that determine timing of retirement. A parsimonious model that incorporates heterogeneity in educational attainment level and stochastic earnings and health predicts the labor force participation rates and Social Security rates by age accurately. This model provides intuition for why college graduates tend to claim Social Security benefits and exit labor force later in life longer life expectancy, non-physically demanding jobs, longer financial planning horizon, and deriving positive utility from work encourage college graduates to retire later.

Chapter two develops and tests a policy rule regarding the availability of reduced early Social Security retirement benefits that would encourage older workers to stay in the labor force longer without amplifying the hardship on the more vulnerable population. The availability of Social Security retirement benefits at the current Earliest Eligibility Age (EEA) is considered the main impediment to longer working lives. Raising the EEA is thus considered the most powerful channel to raise the labor force participation rate. But raising the EEA would create hardship among workers with low private savings who are unable to work or find employment until the higher eligibility age. This study proposes and analyzes a new approach to setting each worker's EEA based on an individual's average lifetime earningsan Elastic EEA. Low average lifetime earnings will likely reflect either poor health or spotty work histories, both of which are associated with weak employment prospects and limited financial resources at age 62. Tying the EEA to the average lifetime earnings could thus protect many of these vulnerable workers while encouraging longer working lives and increasing Social Security monthly benefits for workers more capable of remaining in the labor force. Simulations suggest that an Elastic EEA would achieve its goal in providing higher employment rates and levels of consumption in retirement compared to the status quo. These simulations also demonstrate the limitations of structural retirement models used to estimate the effect of raising the EEA. By assuming the same probabilities of losing and finding a job for all individuals, these models underestimate the adverse effect of raising the EEA on the more vulnerable population.

Although some older workers may like to stay longer in the labor force, they may have hard time holding on to their jobs due to displacement. Chapter three is devoted to the trends in displacement of older workers. Conventional wisdom says older workers are less likely to be displaced. However, the difference in displacement rates between younger and older workers disappeared in the 2006 Displaced Worker Survey (DWS). The increased vulnerability of older workers appears to be the reason for this convergence. To better understand the age-displacement relationship, this study takes advantage of the availability of job tenure information and consistent design of the DWS since 1996. Using a Blinder–Oaxaca decomposition, it analyzes the effect of changes in tenure, industry mix, and educational attainment on the displacement rates of younger and older workers. The results show that older workers are now more likely to be displaced than prime-age workers, conditional on education, manufacturing industry, and tenure.

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Using Educational Attainment to Simplify a Dynamic Model of Retirement

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Abstract

As the U.S. population ages, retirement and Social Security claiming decisions of older workers will have a significant impact on the U.S. economy. It is important then to ask "What are the factors that determine these decisions?" Having a structural model explaining retirement decision allows researchers to analyze the effect of alternative policies on the labor supply and claiming decisions of older workers. Until recently, most men claimed Social Security benefits and exited the labor force at age 62, when they could first claim reduced Social Security retirement benefits, or at age 65, when the full retirement benefits were available. Previous research has found that Social Security rules alone cannot fully explain why workers decide to retire at these ages. As a result, researchers have introduced heterogeneity in time preferences, health insurance coverage, unobserved heterogeneity in types of workers, and fixed costs of work into dynamic models to explain the retirement peaks at ages 62 and 65. These models, however, are often unwieldy. This paper develops a more parsimonious model and replaces these myriad variables with one factor, educational attainment, in a life-cycle model of retirement. According to the Health and Retirement Study, college graduates have less physically demanding jobs and a longer financial planning horizon and simply enjoy working more than non-college graduates. Thus, a simple model that uses only education as a proxy for these characteristics and stochastic health and earnings generates accurate predictions of retirement behavior. As expected, I find that college graduates have a different attitude towards work than their non-college peers.

JEL Classification Codes: J080, J140, J220, J260, J290

Keywords: retirement, life-cycle model, structural retirement model, labor supply decision, Social Security claiming decision

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1 Introduction

Until recently, most men claimed Social Security benefits and exited the labor force at age 62, when they first became eligible for reduced Social Security retirement benefits, or at age 65, when they were eligible for full retirement benefits. Previous research has found that Social Security rules alone cannot fully explain the pronounced retirement spikes at ages 62 and 65.[1] The question is what other factors can explain these retirement patterns. This paper presents a simplified dynamic model of retirement behavior that incorporates heterogeneity in educational attainment, borrowing constraints, and the actuarial adjustments[2] of the Social Security benefit formula. Replacing the myriad variables used in existing dynamic models with educational attainment yields a model that is intuitive, replicable, and easy to use.

Having a relatively simple dynamic model of retirement behavior is extremely important given the aging of the population and the policy changes that will be required to eliminate the projected deficits in Medicare and Social Security. A better understanding of retirement behavior allows researchers to produce more accurate estimates of the effects of policy changes on the labor supply and claiming decisions of older workers and their overall effect on the U.S. economy.

Since the pioneering work of Gustman and Steinmeier (1986), the dynamic stochastic approach has been a valuable tool to model the retirement decision and perform simulations

[1] An average person receives the same present discounted value of the Social Security retirement benefits whether he claims at age 62, 63, 64, or 65 since benefits claimed before age 65 are reduced in actuarially fair fashion to offset the longer claiming period. Thus, it is unclear why people tend to claim at ages 62 and 65.

[2] While reduction for early claiming of about 6.7 percent per year has been constant since early 1960, the delayed retirement credit depends on the year an individual was born. Thus, whether benefit adjustments are actuarially fair or not depends on individual life expectancy and the year an individual was born. See Sass, Sun, and Webb (2007) for more details about the relationship between claiming age and fairness of actuarial adjustments.

to estimate the effect of Social Security policy changes on the retirement decision.[3] The principal challenge of dynamic modeling of retirement behavior is to replicate pronounced peaks in the age-retirement profile at ages 62 and 65.[4] While most existing life-cycle models agree that the spike at age 62 is largely the result of the inability to borrow against future Social Security benefits, different retirement models present competing explanations for the spike at age 65.[5] Rust and Phelan (2000) explain the pronounced peaks at age 65 by the actuarial unfairness of the Social Security benefit formula after age 65 and the availability of Medicare at age 65. Gustman and Steinmeier (2002) explain the retirement spikes at ages 62 and 65 by introducing heterogeneity in time preferences. French (2005) replicates the spikes at age 62 and 65 by combining large fixed costs of work[6] with the actuarial unfairness of the Social Security benefit formula past age 65. Van der Klaauw and Wolpin (2002) introduced unobserved two types of workers into the model and estimated probabilities of being one or the other type. However, all of these models are computationally intensive and hard to understand and replicate.[7] Most importantly, all of these models concentrate their attention on financial incentives ignoring observed heterogeneity in preferences, such as a difference in

[3]See Rust and Phelan (1997) and Blau (2008) for detailed descriptions of the application of dynamic stochastic programming to retirement decision modeling. French (2005) has one of the most comprehensive models describing the labor force participation decision of older workers.

[4]In 1983, legislation gradually raised the full retirement age from 65 to 67. Those born in 1960 or later can claim full benefits at age 67. For the individuals in the sample used for this paper, the highest full retirement age is 65 years and 10 months.

[5]Rust and Phelan (1997) provide an excellent literature review of retirement models explaining spikes at ages 62 and 65.

[6]Disutility derived from participating in the labor force, regardless of the number of hours worked.

[7]The primary goals of replicating any study are to be able to modify, extend, and compare the results. While some researchers provide excellent descriptions of the modeling procedure including programming codes (Rust and Phelan (1997), Rust (2001), and Blau (2008)), others are very vague in their descriptions (Gustman and Steimneier (2005), French (2005)). Availability of programming codes helps other researchers to reconstruct the model in order to modify it for their own purposes. The estimation process being nonlinear, having multiple estimation stages and multiple stochastic components, constant revisions of public data, large number of state and control variables, large number of rules governing thir variables, and dependency of one variable on the others, however, make it difficult and time consuming to comprehend and reconstruct the modeling process, especially for the researchers new to the field. For that reason, the benefits of having a simpler model that works are 1) it could serve as a benchmark and a starting point for those trying to investigate retirement issues and, thus, attract new researchers to the field, and 2) expand the number of datasets to get the range of estimates for the whole population rather than particular samples.

disutility from work[8] for college graduates versus non-college graduates.

My hypothesis is that educational attainment is the main predictor of retirement behavior. College graduates have a longer financial planning horizon and a better understanding of their finances. Chan and Stevens (2003) demonstrate that responsiveness to financial incentives, built in private pension plans and Social Security depends on the level of knowledge of the rules governing these plans. Lusardi and Mitchell (2006) found a correlation between educational attainment and financial literacy and financial literacy and retirement wellbeing. Thus, educational attainment determines to some extent how well people respond to financial incentives, how well people plan for retirement, and how well people prepare for retirement.[9] Moreover, education is an ideal measure: it is available from most surveys; it can be considered exogenous[10] to mid-life labor supply decisions; it is a good predictor for other outcomes at old age, such as health[11] and wealth; and it determines types of jobs and work environment.

The structural retirement model including education is estimated using the Health and Retirement Study (HRS).[12] The HRS is a nationally representative longitudinal data set that

[8]Gustman and Steinmeier (2005) considered heterogeneity in leisure preferences, however, they assumed that the unobserved heterogeneity term is drawn from a normal distribution. Van der Klaauw and Wolpin (2002) introduced two types of workers and estimated probabilities of being one or the other type of worker. The benefit of introducing observed heterogeneity by educational attainment levels are 1) to reduce the number of parameters that needs to be estimated and 2) to provide intuition for the results.

[9]Some may say that people with a long financial planning horizon may want to attend college as positive returns to college happen later in life. Previous literature finds, however, that ability is the strongest predictor of educational attainment (Cawley, Heckman, and Vytlacil (2001)). It is more plausible to assume that college graduates acquire a long planning horizon in the process of learning. Similarly, it is plausible to assume that people with long life expectancy may decide to go to college since they will live long enough to get high return to education. Thus, several papers demonstrate that rising longevity increases the investment in human capital at least at the macro level (Ferreira and Pessoa (2007)). However, there is a strong interdependence between health and education and, thus, longevity and education at the micro level (Gan and Gong (2007), Cutler and Lleras-Muney (2006)). Following the Cutler and Lleras-Muney (2006) suggestion, I assume that college graduates have longer life expectancy and better health due to different decision-making processes.

[10]Overall, education is endogenous to the labor supply decision. However, in retirement models, education can be treated as exogenous since retirement occurs late in life.

[11]One of the driving forces in my model is that college graduates have a longer life expectancy than their non-college graduate peers. Since Social Security benefit adjustments have been developed assuming average life expectancy, college graduates are better off claiming later as they live longer.

[12]The Health and Retirement Study (HRS) is conducted by the Institute for Social Research (ISR) at the

contains demographic, economic, and health information.[13] In addition, the HRS contains "point-blank" questions addressing the perception of work, types of jobs, and the financial planning horizon that helps to substantiate the relationship between disutility of work and education. Thus, descriptive analysis using the HRS demonstrates that 1) college graduates are more likely to say that "work itself is the most important thing"; 2) they have less physically demanding jobs; and 3) they have a longer financial horizon.

Estimation results demonstrate that a simple model with heterogeneous preferences by educational attainment and stochastic earnings and health predicts labor force participation and the claiming decision relatively well, while reducing complexity. As a result, the model presented in this paper is easier to implement and replicate than existing models due to fewer assumptions and lower estimation time. Estimation results also support the stated hypothesis: college graduates have less disutility from work than non-college graduates. While the model developed here does not explain the source of differences in preferences: whether it is due to differences in types of work, attitude toward work, or response to financial incentives, results demonstrate the importance of differentiating between educational groups.

The paper proceeds as follows. Section 2 presents evidence supporting the hypothesis that educational attainment is a good predictor of retirement behavior and that college graduates enjoy work more than their non-college graduate peers. Section 3 sets up the model. Section 4 describes the estimation procedure and presents estimated results. The final section concludes.

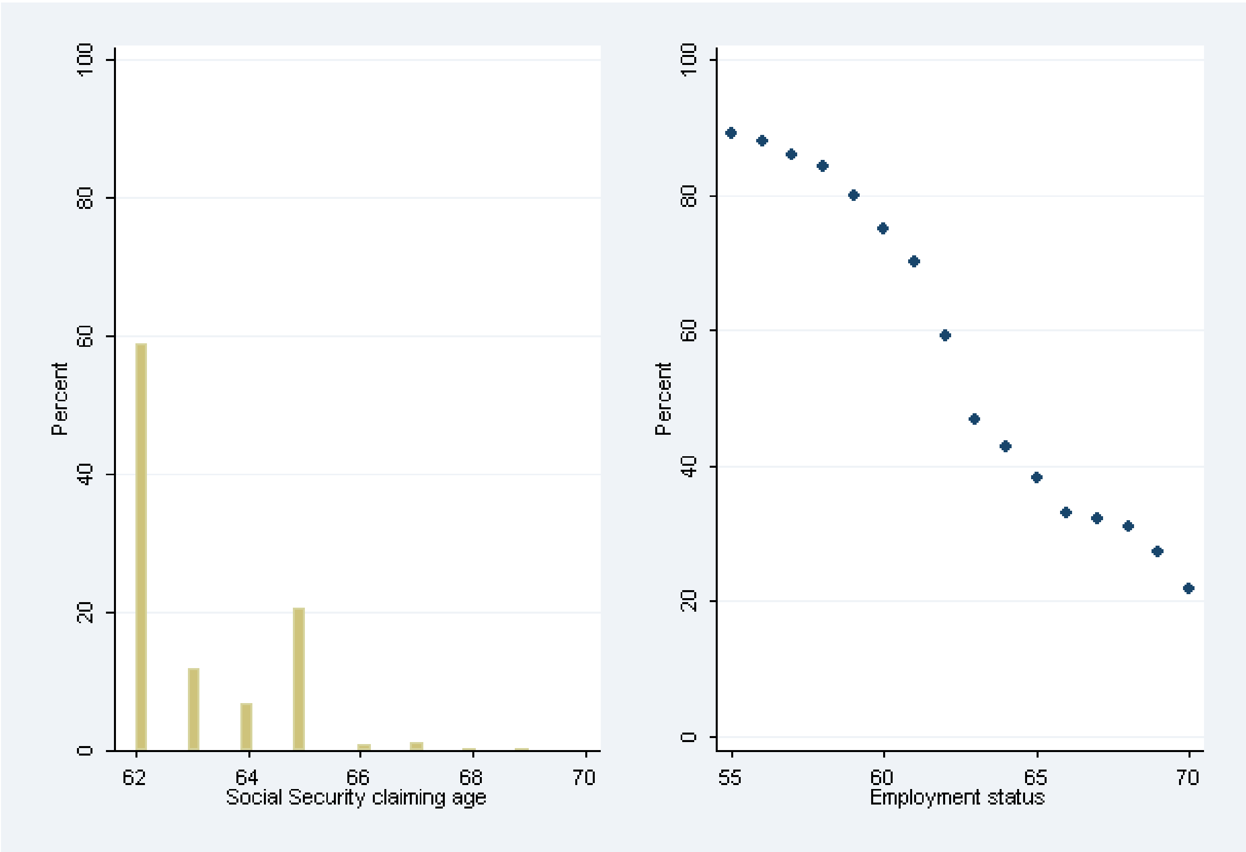

Figure 1: Claiming Age and Employment, Men, HRS, 1992-2006.

2 Retirement Behavior of Older Men

The age at which individuals claim Social Security benefits reveals two clear spikes. Among the HRS sample, nearly 60 percent of male workers claim Social Security benefits at age 62 and about 20 percent claim at age 65 (see Figure 1).[14] Claiming benefits generally means retirement in that most individuals who claim also exit the labor force. In fact, only about 20 percent of those who claim at age 62 remain in the labor force past age 62. Overall, fewer than 40 percent remain employed at age 65 (Figure 1). What factors determine why some individuals claim and retire early and others delay? This section demonstrates that educational attainment level can serve as a proxy for characteristics determining the timing of retirement.

Table 1 shows the characteristics of male workers at age 60 by claiming age. The workers are characterized as "early claimers" (those who claim at 62) and "delayers" (those who claim at 63 or later). These simple descriptive statistics suggest that health status and educational attainment are the main predictors of the claiming age and retirement decision. Individuals in poor or fair health tend to retire early since they may find it difficult to work in general or to find a less strenuous job. In contrast, people with college degrees tend to claim Social Security benefits later in life. My hypothesis is that college graduates have less disutility from work than non-college graduates. There are several explanations for these differences in preference parameters: 1) college graduates simply enjoy working; 2) the types of work that college graduates do allows them to stay longer in the labor force; and 3) college

University of Michigan. For more information go to http://hrsonline.isr.umich.edu/

[13]This study started in 1992 with about 12,650 individuals in their 50s or early 60s. Since 1992 it has been conducted every two years and has introduced new cohorts of the aging population. Currently, it contains information on about 30,000 individuals.

[14]I rounded down for those who claim in the 6th month or earlier (for example, claiming at 62 and 6 months is marked as claiming at age 62) and rounded up for the rest (claiming at 62 and 7 months is marked as claiming at 63).

graduates have a better understanding of the retirement income system and the benefit of staying in the labor force longer and claiming later. The best way to introduce all these explanations is to allow heterogeneous preferences by educational attainment.

The HRS contains questions addressing the perceptions of work, types of jobs, and the financial planning horizon that suggest a relationship between educational attainment and claiming and retirement behavior. Since 1992, respondents have been asked the following two questions addressing the perceptions of work. “Some people think of their work as important mainly because of the money. Others think of the money as less important than the work itself. What about you?” The three possible answers were: “Work important mainly because of the money,” “Work itself the most important thing,” and “Pros and cons.” Respondents were asked whether they agree or disagree with the following statement: “Even if I didn’t need the money, I would probably keep working.” The results presented in Table 2 suggest that attitudes towards work are markedly determined by educational attainment. Half of 51-61 year old college graduates believe that work is “the most important thing.” In contrast, less than a third of non-college graduates share the same belief. Similarly, 75 percent of college graduates would work even if they had enough money versus 66 percent of those with lower educational attainment. Thus, it is reasonable to assume that college graduates enjoy working more than their peers with lower educational attainment. My hypothesis is that college graduates’ lower disutility from work leads them to retire at a later age than non-college graduates.

Although some workers would like to stay in the labor force longer, the types of jobs that they are doing may limit their ability to work longer. Thus, workers in physically demanding jobs may have a hard time to keep up with their job requirements as they get older and their health declines. The HRS has the question that asks how often a respondent’s “job requires lots of physical effort.” Table 2 demonstrates that almost 60 percent of college graduates have jobs that do not require “lots of physical effort,” while only 20 percent of those who did not graduate college have non-physically demanding jobs. Heterogeneity in preference parameters would capture the differences in job requirements.

College graduates are more likely to be financially literate and, thus, better retirement planners (Lusardi and Mitchell (2006)). The HRS provides the following question that allows a comparison of planning horizons among college graduates and their non-college graduate peers: "In deciding how much of their income to spend or save, people are likely to think about different financial planning periods. In planning your saving and spending, which of the time periods ... is most important to you? Next few month, next year, next few years, next 5-10 years, longer than 10 years." Almost twice as many college graduates than non-college graduates have planning horizons longer than 10 years, while almost twice as many non-college graduates than college graduates have planning horizons of the next few months. Thus, college graduates are more likely to respond to the financial incentives built in the Social Security system than non-college graduates and work longer to sustain adequate standard of living over the longer period. A longer planning horizon could be captured by the smaller disutility from work for college graduates relative to non-college graduates.

Previous dynamic models that were designed to explain retirement and claiming have generally overlooked the role of educational attainment. These models often use other characteristics such as health insurance coverage and pension type (see Rust and Phelan (2002); Gustman and Steinmeier (2005)). Individuals who delay claiming of Social Security benefits are more likely to have health insurance from their current employer or a private pension plan (Table 1). However, the difference of claiming behavior by health insurance coverage is smaller than one might expect: just 6 percentage points from Table 1. Furthermore, the observed difference in defined contribution pension coverage can hardly explain peaks in retirement because these plans do not encourage retirement at any particular age (Munnell et al. 2003). In contrast, the difference in educational attainment among "early takers" and "delayers" is much larger at 11 percentage points.

To sum up, the high retirement rate at age 62 appears to be driven by workers in poor health and with low life expectancy who want to exit the labor force early. As workers cannot claim Social Security benefits prior to 62 and they cannot borrow against future retirement benefits, they wait until age 62. Healthy college graduates enjoy working and have higher than average life expectancy. As until recently the financial incentive for the average person to claim past age 65 was small,[15] college graduates usually claimed at age 65.

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3 Model

3.1 Dynamic Programming Approach

In this model, an individual makes a retirement decision, such as when to claim Social Security or whether to work or not, each period according to his own preferences given a certain state of the world. Retirement is not an absorbing state: the agent may change his retirement decision in the next period due to health or earnings shocks. I assume that the claiming age is an absorbing state in that if the agent starts claiming retirement benefits, he has to claim benefits until the end of his life. As an agent's current decision affects his

[15] See Sass, Sun, and Webb (2007) for more details about the relationship between claiming age and fairness of actuarial adjustments.

[16] See Sass, Sun, and Webb (2007) for more details about the relationship between claiming age and fairness of actuarial adjustments.

future set of choices and budget sets, he makes a decision today that maximizes his expected discounted utility over the course of his life.

Due to the complexity of dynamic stochastic modeling, a variety of retirement models exist that differ by both the set of state variables (S_t) that describe the state of the world (such as health status and level of assets) and by the set of control or choice variables (d_t) that describe the agent's possible actions. The choice of state and control variables depends on the researchers' hypotheses. In this model, an agent has two decisions: whether to work in period t (e_t) and whether to claim Social Security (s_t), so that $d_t = \{e_t, s_t\}$. The set of observed state variables, x_t, that determine budget sets and future choice sets include health status (h_t), labor income (w_t), Average Indexed Earnings (AIE), an analogue to average life-time earnings (aie), and Social Security entitlement age (a_t). The major innovation is the inclusion of educational attainment (edu) as a state variable to introduce heterogeneity. Thus, $x_t = \{h_t, w_t, aie, a_t, edu\}$. The set of state variables includes the unobserved state variable ε_t that is known to individuals and unobserved by econometricians that can be interpreted as unobserved heterogeneity in agents' preference parameters. Thus, $S_t = \{x_t, \varepsilon_t\}$. The introduction of the unobserved state variable makes it possible to reconcile data with the constructed dynamic model.

An agent's preferences are described by his utility function, which is a function of state and control variables and preference parameters θ and γ. An individual chooses the optimal sequence of choice variables d_t for $t = 1...T$ to maximize lifetime utility:

$$V_t(S) = \max_{d_t} E\Big[\sum_{\tau=t}^{T} \beta^{\tau-t} u(S_\tau, d_\tau(S_\tau); \theta, \gamma)\Big| S_t = S\Big] \tag{1}$$

or

$$V_t(S) = \max_{d_t} u_t(S_t, d_t; \theta, \gamma) + E\Big[V_{t+1}(S_{t+1})|S_t = S, d_t\Big] \tag{2}$$

where the value function, $V_t(S)$, is equal to the expected discounted utility (assuming that agents follows the optimal policies in the future as well) and β is a time preference parameter, which is the same for all individuals. Note that each individual's expectations depend on his beliefs about uncertain future events, such as probability of death, low income, etc., expressed as a set of transition probabilities $p_t(x_{t+1}|x_t, d_t; \delta)$ where δ is a set of parameters describing beliefs.

By observing the state variables and the decisions that each individual makes in each period of time $\{x_t^i, d_t^i\}, i = 1...I, t = 1...T$, one can estimate the preference parameters (θ and γ) and transition probabilities ($p_t(x_{t+1}|x_t, d_t; \delta)$) by fitting the data to the predictions of the model. I use a two-step approach. First, I find parameters describing beliefs (δ). Then, I substitute the obtained estimates ($\hat{\delta}$) into the model, solve the model using backward recursion, and compare the moments generated by the model with the moments generated by the data by employing the Method of Simulated Moments. I minimize the following function:

$$\min_{(\theta,\gamma)} g(\theta, \gamma)' W^{-1} g(\theta, \gamma) \tag{3}$$

where θ and γ are preference parameters, $g(\theta, \gamma)$ is the distance between simulated moments and moments observed in the data, and W^{-1} is a weighting matrix with the observed moments along the main diagonal and zeros on the off-diagonal. Under the null hypothesis of correct specification, the objective function has a χ^2 distribution with the degrees of freedom equal to the number of moments less the number of estimated parameters. The variance of the parameters is calculated as:

$$\hat{V}(\theta, \gamma) = g'(\theta, \gamma)' W^{-1} g'(\theta, \gamma) \tag{4}$$

where $g'(\theta, \gamma)$ is a vector of the partial derivatives of the moments with respect to the parameters.

3.2 Model Specification

In order to estimate the model, I make the following assumptions about the state and control variables and agents' preferences:

- Time (t): this is a discrete time finite horizon model starting at age 55 and ending with death by age 110.
- Control variables (d_t):
  - *Employment decision* (e_t): An agent must decide whether to work ($e_t = 1$) or not ($e_t = 2$), with a fixed labor supply. I will assume that an agent will be reemployed with probability 1.
  - *Claiming decision* (s_t): An agent must decide when to claim Social Security (1 = apply, 2 = does not apply). An individual cannot claim before age 62 due to Social Security rules. An agent has no financial incentives to postpone claiming after age 70, since benefits are not increased beyond this age and there is no earnings test.

  In this framework, $d_t \in D_t(x_t)$, where $D_t(x_t)$ is the set of the agent's possible actions that depend on the state variables x_t.
- Observed state variables (x_t):
  - *Health status* (h_t): Three stochastic health states are possible at age t: 1 = good health, 2 = bad health, and 3 = dead.

- *Earnings* (w_t): Earnings is stochastic and is divided into 19 equal intervals within the range [5,000; 95,000].[17] Earnings follow an AR(1) process.
- *Average Indexed Earnings* (AIE): The average of the 35 highest maximum taxable annual indexed earnings at age 60. AIE is necessary for the calculation of the Social Security retirement benefit. AIE is divided into 10 equal intervals within the range [0; 72,000].[18] It stays constant for each period of time.
- *Social Security claiming age* (a_t): The claiming age is the age at which the agent starts claiming Social Security benefits. It varies between ages 62 and 70. The level of Social Security benefits is a non-linear function of the claiming age.
- *Educational attainment level (edu)*: Individuals can be college graduates or non-college graduates. The education level for each individual stays constant over time.

- Unobserved state variables (ε_t): A shock to the utility function occurs at time t for each feasible action at that time. The elements of ε_t, conditional on observed state variables x_t, are i.i.d. with a multivariate extreme value distribution. Such a restrictive distributional assumption helps to produce an explicit functional form for the future expected value function. In this case the probability of choosing an alternative d_t has the following representation:

$$P_t(d_t|x_t,\theta,\gamma) = \frac{\exp(v_t(x_t,d_t,\theta,\gamma))}{\Sigma_{d_k\in D_t(x_t)}\exp(v_t(x_t,d_k,\theta,\gamma))} \tag{5}$$

where $v_t(x_t,d_t,\theta,\gamma) = u_t(x_t,d_t;\theta,\gamma) + E\Big[V_{t+1}(S_{t+1})|S_t = S, d_t\Big]$

[17] I use self-reported earnings. The highest level of earnings in the sample is about $95,000.
[18] The highest AIE in the HRS sample is $72,000.

- Utility function (u_t):

$$u_t(S_t, d_t; \theta, \gamma) = \frac{1}{1+\theta_2}\Big[C^{\theta_1} L^{1-\theta_1}\Big]^{1+\theta_2} + \varepsilon(d_t) \tag{6}$$

where

$$\begin{aligned} & L = \\ & 1 + I(working) \times \\ & \Big[\gamma_1 + \gamma_2 I(poorh) + \gamma_3 \frac{t}{t+1} + \Big(\gamma_4 + \gamma_5 \frac{t}{t+1}\Big) I(college)\Big]. \end{aligned} \tag{7}$$

I expect γ_1, γ_2, and γ_3 to be negative. C represents utility from consumption and L represents utility from leisure. The agent is endowed with one unit of leisure which is diminished if the agent works. For workers, leisure diminishes even further with age and declining health. College graduates have different disutility from work, as their jobs are different from jobs of non-college graduates. Thus, $I(working)$ is the indicator function that takes the value of 1 if an agent works and 0 otherwise, $I(poorh)$ is the indicator function that takes the value of 1 if the agent is in poor health, and similarly, $I(college)$ takes the value of 1 if the agent has a college degree. Following Rust and Phelan (1997), age has a smooth and monotonic effect on the utility via the $\frac{t}{1+t}$ functional form. Such a specification, rather than using dummies for each age, makes it possible to prevent the age variables from explaining retirement peaks at ages 62 and 65 themselves. Previous static reduced-form models of retirement behavior have introduced dummies for each age to capture high retirement hazard rates at ages 62 and 65 and estimated high correlations between the age dummies and retirement hazard (Friedberg and Webb (2003)).

- Beliefs ($p_t(x_{t+1}|x_t, d_t; \delta)$): Following Phelan and Rust (1996), I assume rational expectations and "exclusion restrictions." The rational expectations assumption implies that all individuals have the same beliefs that can be described by population probabilities. The "exclusion restrictions" assumption implies the following decomposition of the state variables' transition probabilities:

$$p_t(x_{t+1}|x_t, dt) = p_t^1(w_{t+1}|w_t, college, h_t, age_t) \times p_t^2(h_{t+1}|age_t, h_t) \tag{8}$$

where p_t^1 is an earnings transition probability function and p_t^2 is a health transition probability. Each probability function is estimated separately to find δ, the parameters governing state variables' transition probabilities, and then the estimates of $\hat{\delta}$ are used to find preference parameters in the two-step estimation approach.

To address possible criticism of the assumptions, some comments on the variable selection and specification are in order:

- AIE is assumed to be constant. Theoretically, AIE may only increase due to higher earnings later in life; however, the peak of earnings potential for the majority of individuals occurs before age 55. In addition, any variation in AIE may be mitigated due to dividing AIE into intervals. Thus, the transition probability matrix for AIE is assumed to be an identity matrix.[19]

- Following Phelan and Rust (1996), the current consumption level is equal to the current level of income. This assumption avoids modeling of the consumption/savings decision. The motivation for this assumption comes from two facts: 1) consumption is difficult to measure; and 2) respondents have imperfect information about their retirement savings (Gustman and Steinmeier (2001)).

[19] Rust and Phelan (1996) calculated a transition probability matrix for the Average Indexed Monthly Earnings and find that diagonal elements of the matrix are at least 97 percent of each row.

- For simplification of the model, the retirement decision is limited to the male head of household. Introducing the spouse's retirement decision is left for future research.
- Since individuals' incomes are limited to earnings and retirement benefits, agents are assumed to receive a government transfer if earnings or retirement benefits fall below 20 percent of the poverty level.

4 Estimation Results

The parameters of interest may be divided into two distinct groups: 1) parameters describing preferences and 2) parameters describing individuals' beliefs or expectations about their future health and earnings. This section describes the estimation procedure of the parameters describing beliefs and presents estimation results for both sets of parameters.

Due to a large number of parameters, a two-step approach is employed to simplify the estimation procedure. I first estimate beliefs $p_t(x_{t+1}|x_t, d_t; \delta)$. I simulate agents while randomly assigning their educational attainment level so that the percent of college graduates is the same as that observed in the population. Conditional on the educational attainment level, I assign initial health status randomly. Conditional on the educational attainment level and initial health status, I assign AIE and initial wages that mirror the distributions to that of the population. Using obtained estimates of beliefs and initial conditions, I simulate 10,000 agents and compare the moments of simulated agents with the moments of real individuals. The goal is to find a vector of preference parameters θ and γ that generate moments for simulated agents similar to those observed in the data. I match labor force participation rates between ages 56 and 70 and the percent of individuals claiming at ages between ages 62 and 70. Thus, I have 24 moments to match for each educational category.

As the estimated objective function is not monotonic and has multiple local extrema, traditional optimization algorithms such as hill-climbing algorithms do not work. Thus, I use the method of simulated annealing proposed by Goffe, Ferrier, and Rogers (1994).[20]

4.1 Transition Probabilities

4.1.1 Labor Income

Individuals make retirement decisions based on their expectations about future earnings. Thus, if expected earnings are low/high individuals are more/less likely to retire today. Given a known level of earnings today, what is the probability of having low/high earnings tomorrow? I estimate the earnings equation as an AR(1) process with other explanatory variables in order to obtain transition probabilities for labor income. Based on the estimated parameters of the earnings equation, I find parameters of the distribution function of the residuals and calculate transition probabilities using Tauchen's (1985) approach. The distribution of simulated labor income using estimated transition probabilities is a good approximation of the actual labor income distribution taken from the data. Table 3 presents the results of the log-earnings equation estimation for the sample of male workers who worked for two consecutive periods. The estimated AR(1) process is covariance-stationary with a coefficient of 0.844.

Following Rust and Phelan (1997), I control for the age when workers decide to claim Social Security benefits to take into account changes in their labor supply decisions due to the earnings test.[21] Since retirement benefits are reduced if the agent earns more than a certain threshold and for those who claim before the normal retirement age, the agent may

[20] French (2005) finds that in his dynamic model of labor supply and retirement decision the value function is not concave. He uses a grid search technique to find some of the parameters for his model.

[21] I treat the earnings test as a tax since most individuals perceive it this way. Friedberg (2000) analyzes the effect of the earnings test on the labor supply decision and finds that workers tend to bunch at and just below the earnings exempt amount by reducing their number of hours worked.

reduce the number of hours worked the earnings test minimum.[22] I simulated earnings for all possible claiming ages. That is, the agent has one earnings profile if he decides to claim at age 62, different earnings profile if he claims at age 63, and so on. Thus, the agent takes into account different earnings profiles depending on the claiming age before he makes a decision to claim.

Using the Maximum Likelihood approach, the normal distribution function $N(0, 0.32)$ fits the distribution of the residuals from the earnings equation reasonably well. Figure 2 and Figure 3 present cumulative distribution functions of the simulated and actual earnings and earnings averages by age.

4.1.2 Health and Mortality

This model has three possible states of health: good, bad, and dead. Using the Health and Retirement Study, individuals reporting having "excellent", "very good", and "good" health are considered in good health, and those reporting "poor" or "fair" health are cosidered in bad health. The question of interest is: What is the probability of having good/poor health or dying conditional on current health status? I estimated transition probabilities using a multinomial logit model with age, age^2, and a college graduate dummy as explanatory variables conditional on the agent's previous health status. That is, one transition matrix is for individuals in bad health and one transition matrix for individuals in good health (see Table 4). The distribution of health status by age using the estimated transition probabilities produces a good approximation to the actual health status distribution. Mortality rates obtained from the data are similar to mortality rates published by the Centers for Disease Control in 2003.

[22] Another explanation for significance of the coefficients for the claiming age variables would be unobserved heterogeneity since workers with low earnings potential claim and retire early. Having Average Index Earnings as a state variable allows me to control for lifetime earnings potential.

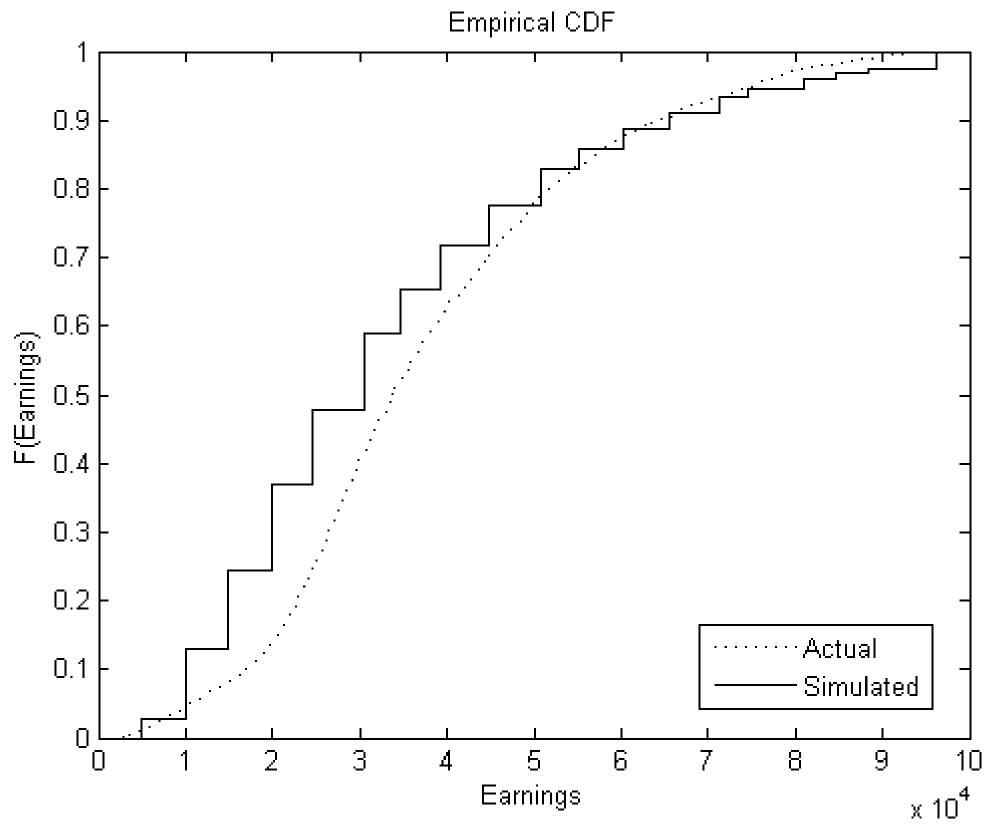

Figure 2: Cumulative Distribution Functions of Simulated and Actual Earnings, Men, HRS, 1992-2006.

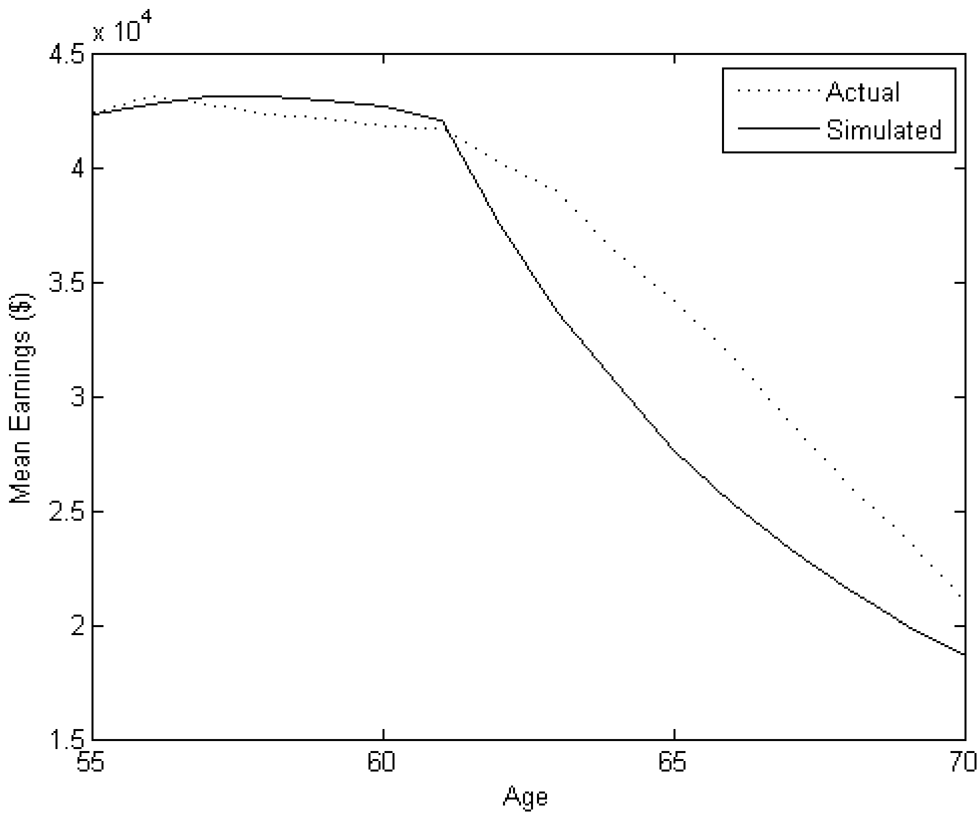

Figure 3: Mean Actual and Simulated Earnings by Age, Men, HRS, 1992-2006.

Figure 4: Percent of People in Good Health, Bad Health, or Dead, Men, HRS, 1992-2006.

Using these estimated parameters, I calculate transition probabilities using the following formula:

$$Pr(h_i = j) = \frac{\exp(X_i \beta_j)}{1 + \sum_j (X_i \beta_j)} \quad (9)$$

where X_i is a vector of individual characteristics and $j \in \{good, bad, dead\}$. Figure 4 compares the distribution of health status by age using actual and simulated data[23].

4.2 Preference Parameters

Table 5 presents estimates of preference parameters of the retirement models for the sample of college graduates and non-college graduates without shocks to the utility function using the Method of Simulated Moments.[24] As expected, college graduates experience lower disutility from work than non-college graduates. Workers in poor health also experience a large disutility from work. As people get older, disutility from work rises.

Surprisingly, even this simple model specification produces quite accurate predictions of the labor supply and claiming decisions (see Figure 5 and Figure 6). The developed model overpredicts the decline in the labor force participation rate at age 62 by about 10 percentage points and underpredicts the decline at age 65 by about 1.5 percentage points. As the model does not include the savings decision nor private pensions, it overpredicts the labor force participation rate at age 61 and underpredicts at age 62. This pattern reflects the fact that individuals have no other sources of income and therefore are forced to claim at 62. Despite these discrepancies, according to the χ^2 goodness of fit test, differences in the simulated moments and the moments observed in the data are negligible.

[23]There is both right and left censoring in the sample used to estimate health transition probabilities. The difference in previous health status before censoring occurs is small: 22 percent of people in bad health among non-censored observations versus 25 percent among censored observations.

[24]I calculate two-sided numerical partial derivatives of the moments with respect to the parameters, that is, $[\theta - \triangle\theta; \theta + \triangle\theta]$, where $\triangle = \frac{1}{450}$. Standard errors displayed in Table 5 are the larger of both directions.

The model developed in this paper has a simple and very intuitive structure relative to previous models. Surprisingly, it is difficult to perform a comparison of the model developed in this paper to the previous models, and previous models to each other, to evaluate the benefits and the costs of the various simplifications and assumptions. Different forms of the utility function and differences in the sets of state and choice variables prevent direct comparison of the estimates and the impact of the estimates on the retirement decision. None of the previous models (except Rust and Phelan (1997) and the model presented here) provide a comparison of the actual and estimated distribution of the claiming age: an outcome of great interest to policymakers. While claiming ages and the labor force participation decision are strongly correlated, changes in Social Security rules may affect this relationship. Gustman and Steinmeier (2005) provide the comparison of observed and simulated retirement hazard by age from full-time work only and report a discrepancy of 2 percentage points in the retirement hazard at age 62.

Assuming a fixed number of hours worked and the functional form of the utility function in this paper, the model presented here is a simplified version of the model in French (2005). However, two key assumptions in French (2005) prevent a direct comparison. First, French (2005) estimates time endowment ranging from 3399 to 4889 hours per year depending on the model specification, rather than normalizing to some constant.[25] Second, his assumption[26] that benefits from private pension plans start at age 62 most likely drives the drop in the labor force participation at age 62 rather than Social Security rules. He finds that poor health has a very small effect on labor force participation, contrary to what Gustman and Steinmeier (2005) and the model developed here find. A relatively high share of people who claim and retire at age 62 are in poor health. These observations suggest that the decline in the labor force participation in French (2005) is due to his assumption about the availability

[25]Traditionally, researchers normalize time endowment to some constant, such as, 1, 24, or number of hours per year less than number of hours sleeping.

[26]Page 406, French (2005).

of private pension benefits.

The estimates presented in Table 5 support the hypothesis that college graduates enjoy less disutility from work than non-college graduates. The coefficient on the college dummy is twice the size of the constant for the disutility from work. Thus, the effect of rising generosity of Social Security benefits since 1970 on labor force participation at age 65 has been mitigated by rising educational attainment. That is, the decline in the labor force participation between 1965 and 1985 would have been even greater were it not for the rise in educational attainment.[27] Thus, ignoring changes in educational attainment over time would underestimate the impact of Social Security reforms.

5 Conclusion

The principal challenge of the dynamic modeling of retirement behavior is to replicate pronounced peaks in the age-retirement profile at ages 62 and 65.[28] While most of the existing literature agrees that the high retirement hazard rate at age 62 is due to the inability to borrow against future Social Security retirement benefits, different retirement models present competing explanations for the spike at age 65. Most retirement models are complex, making them hard to interpret and replicate.

This paper proposes a simple dynamic stochastic model that incorporates heterogeneity in educational attainment, stochastic earnings and health. Its hypothesis is that college graduates enjoy work and, thus, they stay in the labor force longer and claim Social Security benefits later. Since for an average person credit for claiming later (delayed retirement credit)

[27]A forthcoming study by Munnell et al. (2008) reaches a similar conclusion and finds that trends in nation's health improvement in the U.S. have been affected by the rise in educational attainment.

[28]Since early claiming reduces benefits to offset a longer claiming period, making total benefits actuarially fair, researchers have been puzzled by the drastic decline in the retirement hazard rate between ages 62 and 65.

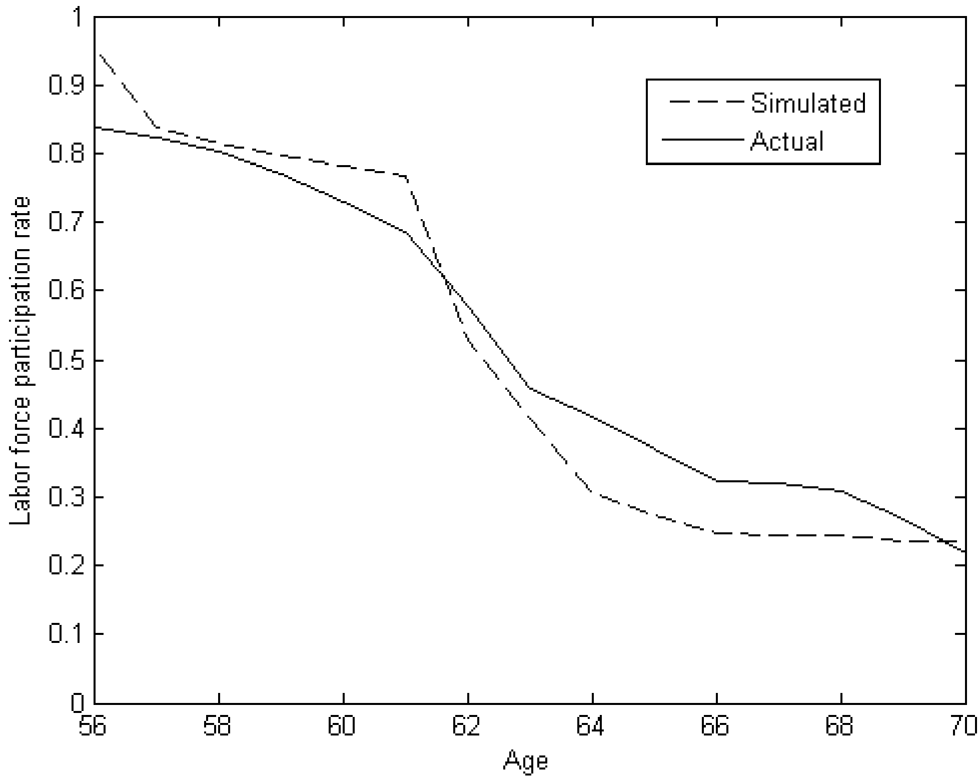

Figure 5: Percent Working by Age for Both Educational Groups, Men, HRS, 1992-2006.

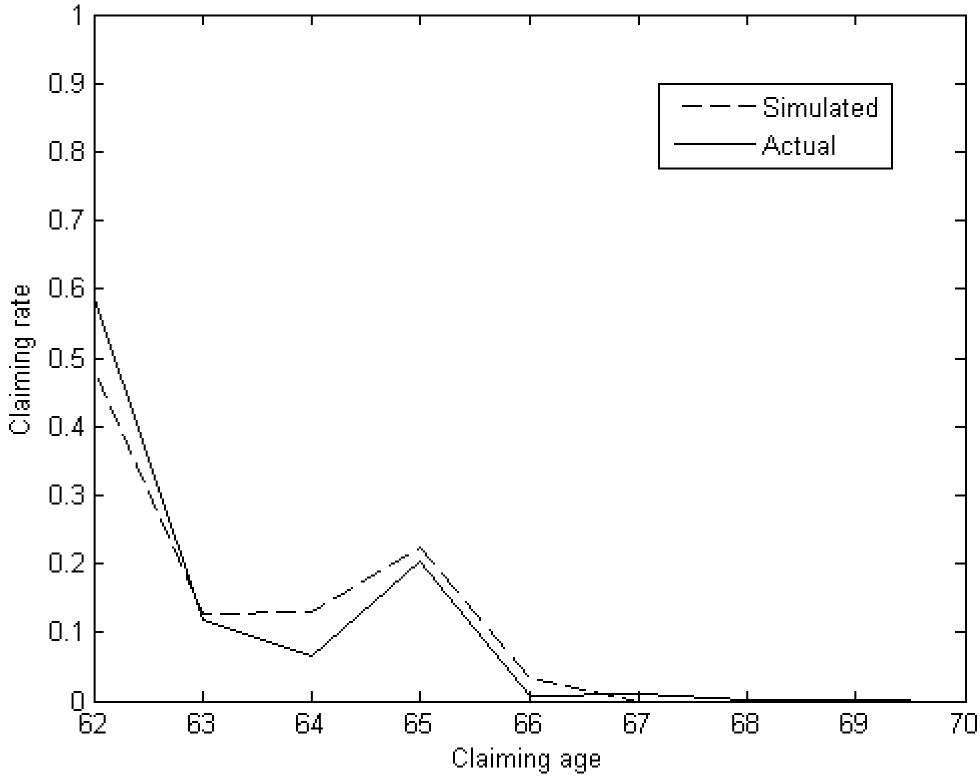

Figure 6: Density of Claiming Age for Both Educational Groups, Men, HRS, 1992-2006.

does not offset the shorter claiming period, college graduates claim at age 65. In addition, as benefit adjustments are actuarially fair for an individual with average life expectancy, those with shorter/longer life expectancy would benefit by claiming earlier/later. The simple model presented in this paper allows for different health transition probabilities for different educational groups. Therefore, college graduates have a longer life expectancy than their peers with lower educational attainment.[29]

Surprisingly, this simple model generates quite accurate predictions of retirement behavior. While more comprehensive models produce better predictions, the model presented here is more intuitive, less computationally intensive, and easier to replicate and extend.

[29]See Cutler et al. (2006) for the link between education and health.

References

[1] Blau, David M. 2008. "Retirement and Consumption in a Life Cycle Model." *Journal of Labor Economics* Vol. 26, pp.35-71.

[2] Cawley, John, Heckman, James, and Edward Vytlacil. 2001. "Three Observations on Wages and Measured Cognitive Ability." *Labour Economics* Vol. 8, Issue 4, pp.419-442.

[3] Chan, Sewin, and Ann Huff Stevens. 2003. "What You Don't Know Can't Help You: Pension Knowledge and Retirement Decision Making." *NBER Working Paper* 10185.

[4] Costa, Dora L. 1998. "The Evolution of Retirement: An American Economic History, 1880-1990." Chicago: University of Chicago Press.

[5] Cutler, David M., and Adriana Lleras-Muney. 2006. "Education and Health: Evaluating Theories and Evidence." *NBER Working Paper* 12352.

[6] Diamond, Peter, and Jonathan Gruber. 1997. "Social Security and Retirement in the U.S." *NBER Working Paper* 6097.

[7] Ferreira, Pedro C., and Samuel de Abreu Pessoa. 2007. "The Effect of Longevity and Distortions on Education and Retirement." *Review of Economic Dynamics* Vol. 10, Issue 3, pp.472-493.

[8] French, Eric. 2005. "The Effects of Health, Wealth, and Wages on Labor Supply and Retirement Behavior." *Review of Economic Studies*, Vol. 72, No. 2, pp. 395-427.

[9] Friedberg, Leora, and Anthony Webb. 2003. "Retirement and the Evolution of Pension Structure." *NBER Working Paper* 9999.

[10] Friedberg, Leora. 2000. "The Labor Supply Effects of the Social Security Earnings Test." *The Review of Economics and Statistics*, 82(1), pp.48-63.

[11] Gan, Li, and Guan Gong. 2007. "Estimating Interdependence Between Health and Education in a Dynamic Model." *NBER Working Paper* 12830.

[12] Goffe, William L., Ferrier, Gary D., and John Rogers. 1994. "Global Optimization of Statistical Functions with Simulated Annealing." *Journal of Econometrics*, Vol. 60, Issues 1-2, pp.65-99.

[13] Gustman, Alan L. and Thomas Steinmeier. 1986. "A Structural Retirement Model." *Econometrica*, Vol. 54, No. 3, pp.555-584.

[14] Gustman, Alan L. and Thomas Steinmeier. 2005. "The Social Security Early Entitlement Age In A Structural Model of Retirement and Wealth." *Journal of Public Economics* 89, pp.441-463.

[15] Goldin, Claudia, Katz, Lawrence F., and Ilyana Kuziemko. 2006. "The Homecoming of American College Women: The Reversal of the College Gender Gap." *NBER Working Paper* 12139.

[16] Gustman, Alan L. and Thomas L. Steinmeier. 2001. "Imperfect Knowledge, Retirement and Saving." *NBER Working Paper* 8406.

[17] van der Klaauw, Wilbert, and Kenneth I. Wolpin. 2002. "Social Security, Pensions and the Savings and Retirement Behavior of Households." Manuscript. University of North Carolina - Chapel Hill.

[18] Lusardi, Annamaria, and Olivia S. Mitchell. 2006. "Financial Literacy and Planning: Implications for Retirement Wellbeing." website: http://ideas.repec.org/p/dnb/dnbwpp/078.html.

[19] Haverstick, Kelly, Sapozhnikov, Margarita, Triest, Robert, and Natalia Zhivan. 2007. "A New Approach to Raising Social Security Earliest Eligibility Age." *CRR Working Paper* 2007-19. Chestnut Hill, MA: Center for Retirement Research at Boston College.

[20] Munnell, Alicia H., Cahill, Kevin E., and Natalia A. Jivan. 2003. "How Has the Shift to 401(k)s Affected the Retirement Age?" *Issue in Brief* 13. Chestnut Hill, MA: Center for Retirement Research at Boston College.

[21] Munnell, Alicia H., and Pamela Perun. 2008. "An Update on Private Pensions." *Issue in Brief* 50. Chestnut Hill, MA: Center for Retirement Research at Boston College.

[22] Munnell, Alicia H., Soto, Mauricio, and Alex Golub-Sass. Forthcoming. "Will People be Healthy Enough to Work Longer?" *CRR Working Paper* . Chestnut Hill, MA: Center for Retirement Research at Boston College.

[23] Rust, John, and Christopher Phelan. 1997. "How Social Security and Medicare Affect Retirement Behavior In a World of Incomplete Markets." *Econometrica*, Vol. 65, No. 4, pp.781-831.

[24] Rust, John. 2001. "Modeling Behavioral Responses to Changes in Social Security: a Life-cycle Framework." Mimeo, University of Maryland.

[25] Samwick, Andrew A. 1998a. "New Evidence on Pensions, Social Security, and the Timing of Retirement." *NBER Working Paper* 6534.

[26] Samwick, Andrew A. 1998b. "Discount Rate Heterogeneity and Social Security Reform." *Journal of Development Economics* Vol. 57, pp.117-146.

[27] Sass, Steven A., Sun, Wei, and Anthony Webb. 2007. "Why Do Married Men Claim Social Security Benefits So Early? Ignorance, Caddishness, or Something Else." *Working Paper 2007-17*. Chestnut Hill, MA: Center for Retirement Research at Boston College.

[28] Social Security Administration. 2003. "Historical Background and Development of Social Security." Website: http://www.ssa.gov/history/briefhistory3.html

[29] Social Security and Medicare Boards of Trustees. 2008. "Status of the Social Security and Medicare Programs: A Summary of the 2008 Annual Reports." http://www.ssa.gov/OACT/TRSUM/trsummary.html

[30] Tauchen, George. 1985. "Finite-State Markov Approximations to Univariate and Vector Autoregressions." *Economics Letters*, 20, 177-181.

[31] U.S. Census Bureau. 2005. http://www.census.gov/population/projections/52PyrmdUS3.pdf

Table 1: Individuals' Characteristics at Age 60 by Claiming Age, Men, HRS, 1992-2006.

	62		> 62	
Characteristic:	*Mean*	*SD*	*Mean*	*SD*
First age observed in the survey	57.61	4.28	59.21	4.34
Last age observed in the survey	70.88	4.03	72.50	3.89
College degree	0.18	0.39	0.29	0.45
Poor/fair health status	0.16	0.37	0.10	0.29
Average index earnings, median	24,607	11,003	23,014	10,081
Household wealth, median	74,611	322,297	56,949	382,378
Work status	0.64	0.48	0.93	0.25
Accumulated number of covered quarters by age 55	126	27	121	28
Employer's health insurance in retirement	0.60	0.49	0.57	0.50
Covered by DB plan on a current job*	0.40	0.45	0.45	0.50
Covered by DC plan on a current job*	0.27	0.39	0.38	0.49
Number of observations	670		465	
Number of observations at age 60	496		303	

Note that number of observation and number of observation at age 60 do not coincide as some respondents entered the survey at later ages. Thus, variables at age 60 are missing.

* - variable has missing values for non-working individuals.

Table 2: Self-reported Perception of Work, Job Requirements, and Financial Planning Horizon, Men, HRS, 1992.

Educational attainment	College	Less than college
Some people think of their work as important mainly because of the money. Others think of the money as less important than the work itself.		
Work important mainly because of the money	29%	51%
Work itself the most important thing	50%	30%
Pros and cons	21%	19%
Even if I didn't need the money, I would probably keep working.		
Strongly agree	19%	13%
Agree	55%	54%
Disagree	18%	24%
Strongly disagree	7%	9%
My job requires lots of physical efforts.		
All or almost all of the time	6%	29%
Most of the time	7%	23%
Some of the time	31%	28%
None or almost none of the time	56%	20%
Financial planning horizon.		
Next few month	10%	18%
Next year	8%	11%
Next few years	29%	34%
Next 5-10 years	38%	30%
Longer than 10 years	14%	8%

Note: Sample includes male respondents between ages 51 and 61 for the first and fourth questions. Sample includes male workers for the second and third questions only.

Table 3: Regression estimation of the male log earnings equation, HRS, 1992-2006.

Variable	Coeff.	SE
Age	0.042	0.044
Age^2	-0.0004	0.0004
College graduate	0.053**	0.012
Poor/fair health dummy	-0.038**	0.015
Log previous earnings	0.844**	0.011
Claiming age at 62	-0.208**	0.024
Claiming age at 63	-0.169**	0.038
Claiming age at 64	-0.099*	0.039
Claiming age at 65 and later	-0.058*	0.024
Constant	0.431	1.310
N	5041	
R-squared	0.8026	

Significance levels : † : 10% * : 5% ** : 1%

Table 4: Multinomial Logit Model of Health Status, HRS, 1992-2006.

Previous health status		Good		Bad	
Outcome	Variable	Coeff.	SE	Coeff.	SE
Bad	Age	1.977**	0.110	-1.659**	0.115
	Age^2	-0.015**	0.001	0.013**	0.001
	College graduate	-0.879**	0.065	-0.439**	0.078
	Constant	-65.837**	3.566	55.219**	3.753
Dead	Age	2.184**	0.297	0.469	0.315
	Age^2	-0.017**	0.002	-0.003	0.002
	College graduate	-0.460**	0.154	-0.586*	0.229
	Constant	-75.747**	9.680	-17.669†	10.325
N		57556		16080	
Log likelihood		-9716.487		-6310.356	

Significance levels : † : 10% * : 5% ** : 1%

Table 5: Preference Parameter Estimates.

Parameter	Coeff.	SE
θ_1 - consumption weight	0.2479	0.008
θ_2 - coefficient of relative risk aversion	-0.8550	0.097
Leisure lost if working:		
γ_1 - constant	-0.2108	0.011
γ_2 - poor health	-0.5266	0.133
γ_3 - age	-0.2521	0.007
γ_4 - college	0.4673	0.016
γ_5 - age*college	-0.5222	0.018
Calibration:		
β - time discount factor	0.98	
Goodness of fit (41 df) : χ^2	1.6196	

Tying the Social Security's Earliest Eligibility Age to Lifetime Earnings

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January 14, 2009

Abstract

Will older Americans work longer if we raise Social Security's Earliest Eligibility Age, and can we do so in a way that would avoid amplifying the hardship on the more vulnerable population? As the national retirement income system generates less income in retirement than it did in the past, working longer is perhaps the best option to guarantee an adequate income in retirement. Availability of Social Security retirement benefits at the current Earliest Eligibility Age (EEA) is considered the main impediment to longer working lives. Raising the EEA is thus considered the most powerful channel to raise the labor force participation rate. But raising the EEA would create hardship among workers with low private savings who are unable to work or find employment until the higher eligibility age. The idea of raising the EEA has been widely debated in the literature. This debate has produced two proposals that would raise the EEA to age 64 for all workers and that would tie each worker's EEA to the length of their working years. Both proposals, however, fail to protect vulnerable workers. This study proposes and analyzes a new approach to setting each worker's EEA based on an individual's average lifetime earnings. Using data from the Health and Retirement Study, this paper demonstrates that low average lifetime earnings are associated with poor health, weak employment prospects, and limited financial resources at age 62. Using a dynamic stochastic retirement model developed by Zhivan (2008b), this paper addresses the following issues regarding an Elastic EEA relative to policy alternatives. To what degree does it 1) result in workers staying in the labor force longer, 2) result in a higher level of retirement benefits, consumption, and utility, and 3) reduce the number of potential federal aid recipients. Simulations

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[†]I would like to thank Kit Baum, Norma B. Coe, Donald Cox, Richard W. Kopcke, Alicia H. Munnell, Steve Sass, and Robert Triest for their valuable advice. All errors are mine. Comments are welcome.

suggest that an Elastic EEA would achieve its goal in providing higher employment rates and levels of consumption in retirement compared to the status quo. Simulations also demonstrate the limitations of structural retirement models used to estimate the effect of raising the EEA. By assuming the same probabilities of losing and finding a job for all individuals, these models underestimate the adverse effect of raising the EEA on the more vulnerable population.

JEL Classification Codes: H55, J26
Keywords: Earliest Eligibility Age, Elastic EEA, Social Security, retirement model, Social Security claiming decision

1 Introduction

The contraction of the national retirement income system, along with several other factors, raises concerns among older workers about the adequacy of their retirement wealth.[1] "Working longer" slogans fill current publications on retirement as the key remedy to falling financial security in retirement (Munnell and Sass (2008)). The question is what can be done to encourage longer working lives? The availability of Social Security retirement benefits at the current Earliest Eligibility Age (EEA) is considered the main impediment to any attempt to encourage longer working lives. About 50 percent of the population claims Social Security benefits at age 62, the current level of the EEA, when reduced retirement benefits are first available. Most individuals who claim early also exit the labor force early. Thus, reforming the EEA is considered the most powerful tool that the government could use to encourage longer working lives. This study proposes a new approach for setting the EEA that would encourage older individuals to stay in the labor force longer while minimizing harm to the more vulnerable population. Using the Health and Retirement Study, this study demonstrates the connection between average lifetime earnings and the risk of belonging to the more vulnerable group of workers, thus providing a rationale for setting individual EEAs. Using a dynamic stochastic retirement model developed by Zhivan (2008b), this paper then analyzes the behavioral response of older workers and performs a welfare analysis of the new policy rule.

As the U.S. population ages and national retirement income contracts, the current labor force participation trend would leave growing numbers of retirees in poverty and create

[1]The national retirement income system is contracting and is generating less income in retirement than it did in the past because 1) the Full Retirement Age is rising from age 65 to 67, thus, cutting benefits claimed at any age, and 2) the nature of private pensions has changed from predominantly defined benefit plans to predominantly defined contribution plans. Households save less for retirement under defined contribution compared to defined benefit pension plans (Munnell and Sass (2008)).

additional pressure on already strained social programs. The Full Retirement Age (FRA) when the full retirement benefits are available is rising from age 65 to 67, leaving workers and their spouses that claim at age 62 at risk of having very low incomes later in life. Life expectancy at age 65 for males has risen from 13.1 years in 1950 to 17.5 years in 2007 (SSA, 2008). The corresponding numbers for women are 16.2 years in 1950 to 19.8 years in 2007. Given the current trend in retirement and rising longevity, future workers will have to save more to be able to finance more years in retirement. The alternative is longer working lives. According to Munnell and Sass (2008), an additional three or four years in the labor force could offset the effect of the contraction of the retirement income system. Raising the EEA is generally seen as the most effective tool for extending working lives. As the government ultimately bears responsibility through social welfare programs for the retirees that fail to achieve an adequate standard of living in retirement, policymakers should address changes in the EEA sooner rather than later.

The idea of raising the EEA has been widely debated in the literature, producing two main proposals.[2] One would raise the EEA uniformly to age 64, while a second would raise the EEA for most workers, but allow a lower EEA for who have been in the labor force for many years. The traditional approach is to raise the EEA to age 64 for all individuals in line with the rise in the FRA (Gustman and Steinmeier (2002), French (2005)). Such a change, however, could create a serious hardship for workers with health problems and/or physically demanding jobs who are unable to work later in life. Other proposals for having "adjustable" EEAs would tie the Earliest Eligibility Age to the length of a worker's labor force participation (Haverstick et al. (2007)). The notion is that more vulnerable workers

[2]Favreault et al. (2006) suggest that keeping the EEA at age 62 and setting minimum benefits would assure low-wage workers who retire early a basic income. However, it would disregard the tendency of early claiming and retiring behavior among workers capable of staying in the labor force. Another approach is to conduct an educational campaign that would alert all workers of the benefits of claiming later, and fixing the minimum survivor benefit at the spouse's Full Retirement Age benefit, paid for by further reducing early retirement benefits, which would combat myopia and assure widows and widowers higher monthly incomes (Sass, Sun, and Webb (2007)).

generally have long careers — they generally have a high school education or less, go to work early, have physically demanding jobs, and are not in a good position to keep working past age 62. But such proposals, while seemingly intuitive and relatively easy to implement, fail to produce the desired outcomes. The individuals that need greater income protection often have lower labor-force participation[3] due to higher employment volatility than do healthier and more successful workers (Favreault and Steuerle (2008)).

This study proposes another approach to setting the EEA in terms of its ability to encourage longer working lives while protecting the more vulnerable members of the population. The idea is to base the individual's EEA on their Average Indexed Earnings (AIE) at age 55. Low average lifetime earnings will likely reflect either poor health or spotty work histories, both of which are associated with weak employment prospects and limited financial resources at age 62. A worker's ability to work and find a job generally does not change suddenly from age 55 to age 62. Therefore, a worker's AIE at 55 is a reasonably good measure of the worker's employment prospects at 62. In addition, workers with low lifetime earnings are unlikely to have accumulated sufficient financial assets to support themselves until eligible for Social Security benefits at age 64. Tying the EEA to the AIE could thus protect many of these vulnerable workers while encouraging longer working lives and increasing Social Security monthly benefits for workers more capable of remaining in the labor force.

This study uses data from the Health and Retirement Study[4] to demonstrate the correlation between Average Indexed Earnings and the risk of belonging to a more vulnerable group of workers. The study then uses a dynamic stochastic retirement model, developed by

[3]Labor force participation is measured by the Social Security program as the number of covered quarters that determine eligibility for Social Security benefits.

[4]The HRS is a nationally representative longitudinal data set that contains demographic, economic, and health information. This study started in 1992 with about 12,650 individuals in their 50s or early 60s. Since 1992 it has been conducted every two years and has introduced new cohorts of the aging population. Currently, it contains information on about 30,000 individuals. The current analysis is limited to a sample of men. As most women have interrupted work histories some modifications to the policy rule is required to take into years spent caring for young children and elderly parents. For more information go to http://hrsonline.isr.umich.edu/.

Zhivan (2008b), to analyze the behavioral response of older individuals and to perform a welfare analysis of the new policy rule. This model will allow comparisons of the policy-relevant outcomes of the Elastic EEA relative to a uniform EEA at ages 62 or 64. In particular, it will indicate the degree to which the Elastic EEA, relative to other policy rules, 1) results in older workers staying in the labor force longer, 2) provides a higher level of retirement benefits, consumption, and utility, and 3) reduces the number of potential federal aid recipients.

Simulations based on the model by Zhivan (2008b) suggest that an Elastic EEA would encourage longer working lives and increase workers' consumption level in retirement. The proposed policy rule would also allow workers with low earnings potential to retire early. While increasing the average level of consumption in retirement, an Elastic EEA does not reduce poverty in retirement since low life-time earners would claim reduced Social Security benefits. However, none of the existing proposals regarding the EEA can improve the standard of living of the more vulnerable population except by providing a minimum level of benefits for those falling below the poverty level. Thus, the combination of an Elastic EEA with the expansion of other social programs could be a feasible policy to encourage longer working lives.

Simulations also demonstrate the limitation of structural retirement models, which have been used to estimate the effect of raising the EEA. Models assuming the same probabilities of losing and finding a job for all individuals underestimate the adverse effect of raising the EEA on the more vulnerable members of the population. Thus, modeling heterogeneity in job opportunities is an essential part of evaluating the distributional aspect of any EEA policy rule. Unfortunately, differences in labor market demand for workers with different earnings potentials have not been well documented.

The paper proceeds as follow. Section 2 describes arguments for and against raising the EEA. Section 3 proposes an Elastic EEA rule that assigns different EEAs to different individuals based on their Average Indexed Earnings. Section 4 analyzes the behavioral response to the proposed policy and welfare analysis using a dynamic model. Section 5 concludes.

2 Arguments Relating to the EEA

Proponents of raising the Earliest Eligibility Age (EEA) argue that such a policy would encourage longer working lives and maintain adequacy of Social Security-based retirement income. Working longer prevents premature depletion of retirement savings and provides current income. Overall, given workers' rising longevity and the declining share of physically demanding jobs, later retirement seems a reasonable way to provide financial security in retirement. Opponents, on the other hand, believe that raising the EEA would hurt workers who find it difficult to work due to poor health or poor job prospects, and are likely to have inadequate savings to fund a deferral of their benefits.

2.1 Pro: Improved Retirement Security

While Social Security income is not intended to be the only source of income in retirement, about one-third of the households receiving Social Security derive 90 percent or more of their income from this program (SSA, 2006). However, a low earner — a worker making 45 percent of the national average wage all his life — receives an annual benefit of $9,685 at the Full Retirement Age (FRA): an amount that barely exceeds the poverty threshold (see Table 1). The benefits of average and high earners — workers making 100 and 160 percent of the national average wage respectively — at the FRA are well above the poverty threshold. With the FRA at age 67, however, early claimed benefits, actuarially reduced to offset the longer period of benefits receipt, approach or even fall below the poverty threshold for all types of workers. The problem is illustrated in Table 1. Retirement benefits for a low earner would replace 71 percent of poverty line income if claimed at 62. The average earner would be less than 20 percent above the poverty threshold, while a high earner would receive approximately 50 percent more that the poverty line if they claim benefits at age 62. Postponing the claiming decision until age 64 would clearly improve retirement income security. Average and high earners would get 1.35 and 1.75 of the poverty line if claimed at age 64. However, a low earner would still fall 20 percent short of this minimum required standard of living in retirement.

2.2 Pro: Working Longer

Raising the EEA would encourage longer working lives. The contraction of the national retirement income system along with several other factors raise a concern among older workers about the adequacy of their retirement wealth. The "working longer" slogan fills current publications on retirement as the key remedy to falling financial security in retirement. Availability of early retirement benefits, however, encourages early exit from the labor force (Samwick (1998), Rust et al. (1997)). Zhivan (2008b) finds that only about 20 percent of early claimants stay in the labor force until age 65. If the EEA were to be raised to age 64, one recent study estimates that about 60 percent of those who currently retire at 62 would retire at 64 (Gustman and Steinmeier (2005)). In addition to raising these workers' monthly Social Security benefits, their earnings from work would directly increase current income and delay the draw-down of private retirement savings.

Table 1: Annual Social Security Benefit by Claiming Age if the FRA in 2005 were 67.

	Claimed at 67		Claimed at 64		Claimed at 62	
Earner type:	Benefit	% of poverty	Benefit	% of poverty	Benefit	% of poverty
Low earner	$9,685	101	$7,748	81	$6,780	71
Average earner	16,189	169	12,951	135	11,332	118
High earner	20,942	219	16,753	175	14,659	153

Note: National average wage was $36,953 in 2005. The poverty threshold for a one-person household in 2005 was $9,570. By the definition of the Social Security Administration, a low earner makes 45 percent, an average earner 100 percent, and a high earner 160 percent of the national average wage.
Source: Author's calculation based on SSA national average wage information
and the 2006 OASDI Trustees Report.

Table 2: Incidence if Risk Factors at Age 63 for Men by Claiming Age, HRS, 1992-2006.

Characteristics	Claimed at 62	Claimed at 63 or later
Work-limiting health conditions	20%	10%
High-school diploma or less	62	50
Ever applied for DI or SSI	10	4
Subjective probability of not living to age 75 (median)	30	20

Note: Sample includes all male respondents for whom claiming age and health as of age 63 are observed excluding those who had a longest job in public administration and those who receives DI.
Source: Author's calculation from the HRS, 1992-2006.

2.3 Con: Hardship for Those at Risk

The most important argument against raising the EEA is that it would create hardship for those who find it difficult to work in their early 60s due to poor health or poor job prospects. Individuals with high earnings potential could save enough early in life outside the Social Security system to support themselves for an additional two years in case of poor health or poor job opportunities. Low-income individuals with serious health problems could rely on Social Security disability benefits (DI) during this period. However, low-income workers with insufficient assets, unqualified for DI, and with poor job prospects could find it difficult to support themselves until age 64 without government support. Indeed, health problems and weak labor-market prospects are quite common among workers who claim at age 62. Roughly 20 percent of all men who claim at age 62 report a work-limiting health condition, as opposed to 10 percent of men who claim later (Table 2). About two-thirds of these early takers have a high school diploma or less. Older workers with low educational attainment have especially poor job prospects (Mosisa and Hipple, 2006) and are disproportionately prone to displacement (Munnell et al. 2008). Less educated older workers are also less likely to have adequate private pensions or other financial resources (Lundberg et al. 2000). Raising the EEA would thus require workers with health and labor-market problems to prolong their work lives or have inadequate incomes until age 64. Even under the current Social Security rules a larger percent of early takers applied for DI or SSI versus those claiming later. Raising the EEA could significantly increase the number of people turning to Social Security Disability Income (DI), Supplemental Security Income (SSI) or social services, all of which are cumbersome and expensive to administer, discourage work or saving, and often stigmatize participants.

2.4 Con: Unfairness to Groups with Short Life Expectancy

Raising the EEA is unfair to workers with a below-average life expectancy, such as low-wage workers and African-American men. Forcing workers with average life expectancy to claim at age 64 rather than age 62 does not reduce the value of lifetime benefits, but it does reduce the value of lifetime benefits for workers with below-average life expectancy, such as these two cohorts. According to Table 2 early takers expect shorter lives compared to those claiming later. Because such workers receive benefits over a shorter period of time, the lifetime value of benefits claimed at any age is less than the value received by workers with a greater life expectancy. But the disparity is greater for benefits claimed at age 64 than age 62 because the two-year reduction in benefit receipts represents a greater share of a shorter life expectancy. If the EEA were raised from age 62 to 64, the lifetime value of a given monthly benefit claimed at the EEA by African-American men would fall from 89 to 87 percent of the value received by whites. Workers in the lower half of the earnings distribution do not receive the same monthly benefits as workers in the top half of the distribution. But if they did, the lifetime value of benefits claimed at the EEA by workers in the bottom half of the distribution would fall from 83 to 81 percent of the value received by workers in the top half of the distribution.[5]

[5]Life expectancy for 60 year-old men is 18 years for African-Americans and 21 years for whites (Centers for Disease Control, 2003). Life expectancy for 60 year-old men is 20 years for workers in the bottom half of the earnings distribution and 25 years for workers in the top half of the distribution (Waldron, 2007). The lifetime value of a given monthly benefit is calculated using a 3 percent real interest rate.

3 Setting Social Security's Earliest Eligibility Age Based on Lifetime Earnings

The policy objectives for reforming the EEA are to improve retirement income security while minimizing the hardship and unfairness it creates. The traditional approach would raise the EEA and address the adverse effects using other public programs or by changing other features of the Social Security program.[6] The alternative is an Elastic EEA, which assigns different workers different earliest claiming ages, based on a rule that achieves these policy objectives.

3.1 Average Lifetime Earnings as a Predictor of Being Vulnerable in Old Age

An Elastic EEA could potentially raise the earliest claiming age for most workers while shielding those for whom a higher EEA would result in hardship or an unfair loss of benefits. A key concern is how to assign EEAs to accomplish this objective. The idea is based on the observation that individuals in poor health at age 63 have earnings lower than earnings of healthy individuals over the entire course of their lives (Figure 1).[7] On the one hand, this

[6]The adverse effects of a higher EEA could be addressed by adjustments in other public programs. The hardship could be mitigated by expanding the Social Security Disability Insurance (DI) and Supplemental Security Income (SSI) programs or other social welfare programs. The unfairness could be offset within a larger package of reforms that produced a more even overall distribution of gains and losses, such as adjustments or offsets to the payroll tax or to a further increase in the FRA, which disproportionately hurts higher earners (Munnell, et al. 2004; Mermin and Steuerle, 2007). But expanding DI, SSI, or public means-tested programs is messy, costly, and often poorly targeted and inconsistently applied (Autor and Duggan, 2006). And no large package of Social Security or welfare reforms that include such offsets to unfairness is working its way through Congress. So while the adverse effects of a higher EEA could be mitigated by changes in other public programs, this approach to raising the EEA has gained little traction.

[7]"Healthy" refers to individuals reporting good, very good, or excellent health. "Unhealthy" refers to individuals reporting fair or poor health. Health status is measured at age 63.

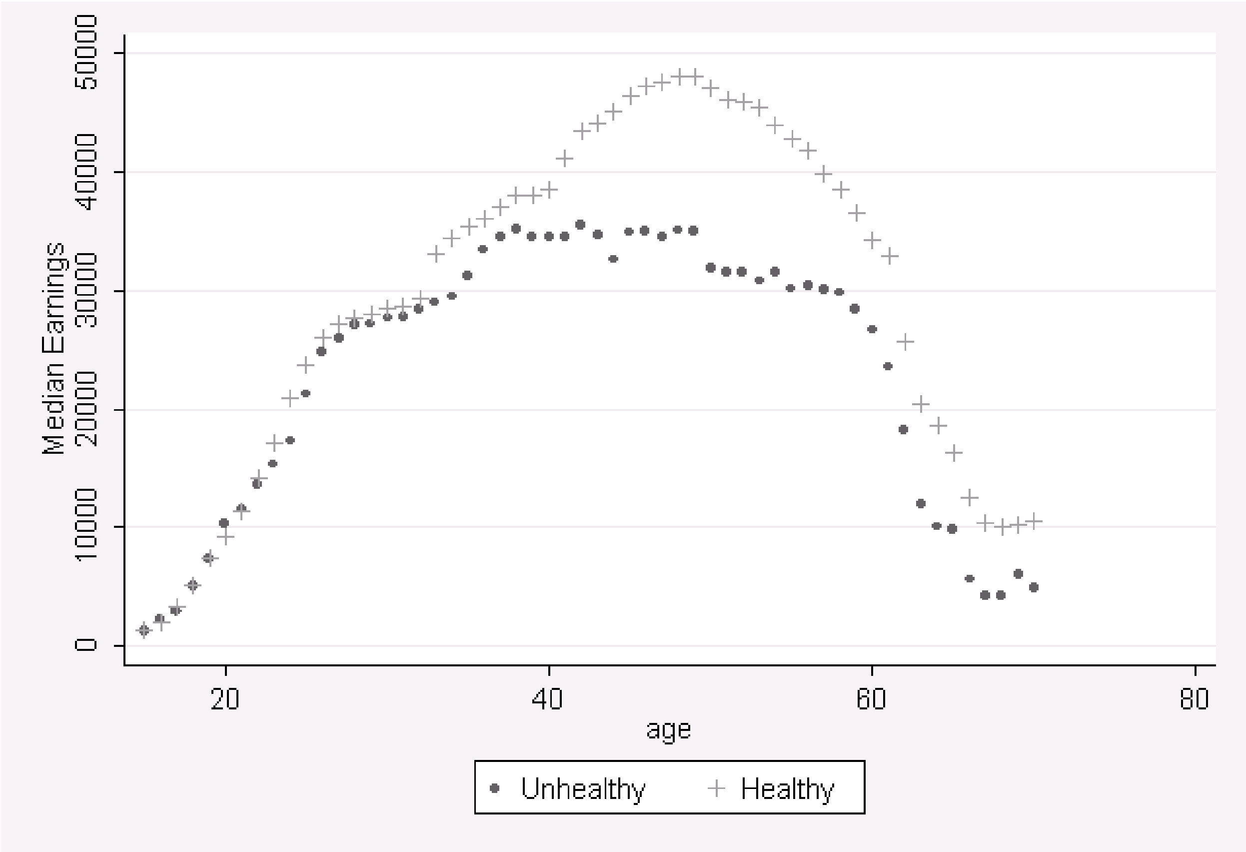

Figure 1: Median Covered Earnings by Health Status at Age 63, HRS, 1992-2004

Table 3: Incidence if Risk Factors at Age 63 for Men, by Ratio of Average Indexed Earnings (AIE) to National Average Earnings (NAE), HRS, 1992-2006.

Characteristics	AIE<50% NAE	50-100% NAE	AIE>100% NAE
Poor/fair health	33%	26%	13%
Work-limiting health conditions	30	19	15
Less than high-school diploma	44	38	20
Ever applied for DI or SSI	24	11	5
Subjective probability of not living to age 75 (median)	50	40	30
Financial assets less than 2 years' earnings	44	50	32
Percent of men with the ratio	12	16	72

Note: The ratio of Average Indexed Earnings to National Average Earnings is calculated when the worker is age 55. Sample includes male workers with earnings histories excluding those with the longest job in public administration and those receiving DI.

correlation could be explained by the fact that unhealthy workers have poor job opportunities. On the other hand, it is also consistent with the hypothesis that low earnings cause poor health. Sullivan and von Wachter (2006) show that job loss reduces life expectancy. One possible explanation is that lack of access to health insurance, unhealthy life style due to low earnings, and stress associated with volatile employment may have a negative impact on health. In addition, it is well known that workers with low educational attainment have earnings lower than of college graduates over the course of their lives. Since low educated workers have poor job prospects at older ages, tying the EEA to Average Indexed Earnings protects this type of worker. Thus, an Elastic EEA would protect both groups of people: those who cannot work due to poor health and those who cannot find employment in old age. Protecting such workers from a general increase in the EEA would improve retirement income security while mitigating the hardship and unfairness such a change would otherwise produce.

Table 3 shows the relationship between estimated average lifetime earnings at age 55, as measured by AIE relative to the national average wage, both as calculated by the Social Security Administration, and various worker characteristics at age 63 that could create hardship or unfairness should the EEA be raised. The method used to estimate average lifetime earnings is biased downward for certain workers. This bias occurs because the AIE calculation includes only earnings covered by the Social Security program and does not count wages earned abroad (either by immigrants or U.S. workers employed outside the United States) or wages earned while employed by a state or local government not covered by Social Security.[8] Nevertheless, low average lifetime earnings, as given by this measure, are clearly associated with a lack of financial assets, fair or poor health, a work-limiting health condition, low educational attainment, subjective life expectancy (which has been shown to be a reasonably

[8]We do exclude workers whose longest job, as recorded by the HRS, is employment in state or local government.

good indicator of actual life expectancy) and ever having applied for DI or SSI benefits.

An elastic EEA based on average lifetime earnings thus seems capable of addressing the issues of hardship and fairness. As the Social Security Administration already calculates average indexed earnings for each worker, an elastic EEA based on average indexed earnings would be reasonably easy to implement.

3.2 An Elastic EEA

A simple example of an EEA based on average indexed earnings (AIE) is shown in Figure 2. For workers with AIE of 50 percent of the national average earnings or less, the earliest claiming age could remain at 62. For workers with AIE equal to or greater than the national average wage, the earliest age of claiming would rise to 64. For workers with AIE between 50 and 100 percent of national average earnings, the earliest age of claiming would rise by a month for each 0.48 percentage point increase in AIE above 50 percent of the national average earnings. For example, a worker with an AIE equal to 75 percent of the national average earnings could claim at 63 (25 x .48 = 12 months).[9]

This simple specification would be reasonably successful in achieving policy objectives for reforming the EEA. As shown in Table 3, the earliest claiming age would rise to 64 for close to 70 percent of men, with fewer than 15 percent eligible at 62. About 80 percent of current early claimers would have to wait for at least another year to claim Social Security.

Each worker's earliest claiming age should be set early enough so that workers could adjust their retirement plans. In the example presented below, EEAs are based on a worker's AIE relative to the national average wage at age 55. There is not much change in men's AIE (relative to national average earnings) between 55 and 62 (Rust and Phelan (1997)),

[9] Gradually raising the EEA avoids abrupt changes in eligibility in response to minor changes in earnings, dampening the moral hazard that workers would reduce earnings to qualify for benefits earlier.

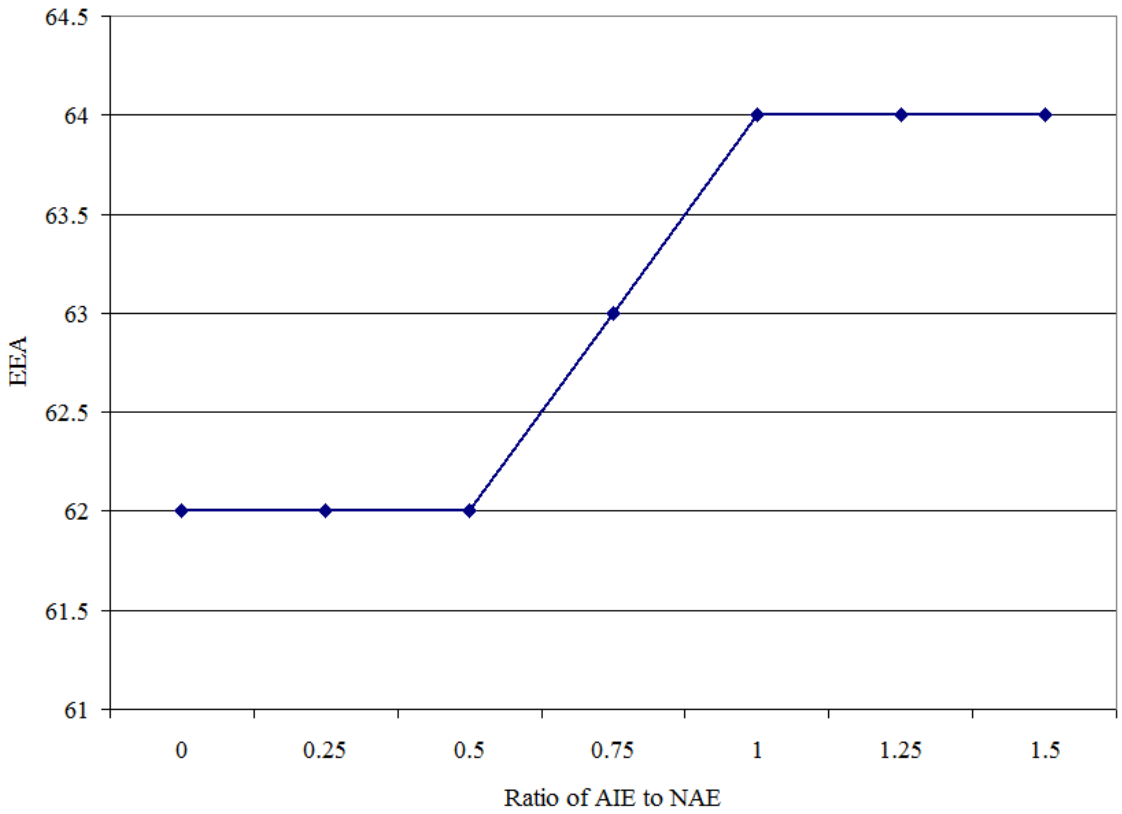

Figure 2: Example of an Elastic EEA based on Average Lifetime Earnings

their EEA would generally be much the same whether set at 55 or 62. Notifying workers of their EEA at age 56 would also function as a "wake-up call" to plan for retirement.[10] At the same time, calculating AIE at age 55 eliminates the need to deal with a moral hazard problem where individuals intentionally reduce labor supply to reduce AIE. Individuals are unlikely to agree voluntarily to receive low lifetime earnings just to reduce the eligibility age by two years.

4 Behavioral Response to the Introduction of an Elastic EEA

Will older Americans work longer and live better under an Elastic EEA? A life cycle model of retirement developed by Zhivan (2008) can provide crude estimates of the effect of an Elastic EEA on the employment decision, level of consumption and overall utility, and federal finances.[11] Having the same trajectories for the evolution of health and earnings, I simulate the employment and claiming decisions for each individual using three scenarios: 1) the EEA is set at age 62, 2) the EEA is set at age 64, and 3) the EEA is set for each individual based on his average life-time earnings. Thus, differences in policy rules of setting the EEA are the only source of differences in outcomes of all three simulations. This section summarizes the stochastic dynamic model of retirement and provides estimates of the Elastic EEA effects on the well-being of older Americans. Due to the simplicity of the model's specification, the following results are suggestive. But these simulations provide a clear graphical illustration of the pros and cons of raising the EEA and limitations of existing

[10] Setting the EEA much earlier might not be useful, as most men in their mid fifties have a financial planning horizon of less than five years (Haverstick et al. 2007).

[11] See Rust (2001) for the discussion of such a "controlled experiment" using a life-cycle approach.

structural retirement models.

4.1 The Life-Cycle Model of Retirement

In this model an individual makes a retirement decision, such as when to claim Social Security or whether to work or not, in each period according to his own preferences given a certain state of the world. Retirement is not an absorbing state: the agent may change his retirement decision in the next period due to health or earnings shocks. I assume that the claiming age is an absorbing state in that if the agent starts claiming retirement benefits, he must claim benefits until the end of his life. As an agent's current decision affects his future set of choices and budget sets, he makes a decision today that maximizes his expected discounted utility over the course of his life. The set of state variables includes the following variables: health status, earnings, average indexed earnings, Social Security claiming age, and educational attainment level. The control variables are the employment and claiming decisions.

4.2 The Labor Force Participation Decision

Figure 3 shows the effect of raising the EEA on the employment decision of older workers using different policy rules. As we would expect, setting the EEA at age 64 would encourage workers to stay employed until they can start claiming Social Security benefits. Similarly, the employment rate of older workers under the Elastic EEA policy rule is higher compared to the current policy rule and lower compared to a fixed EEA at age 64. However, the differences in the employment rates between the EEA at age 64 and the Elastic EEA are only one and ten percentage points at ages 62 and 63, respectively. Thus, this simulation

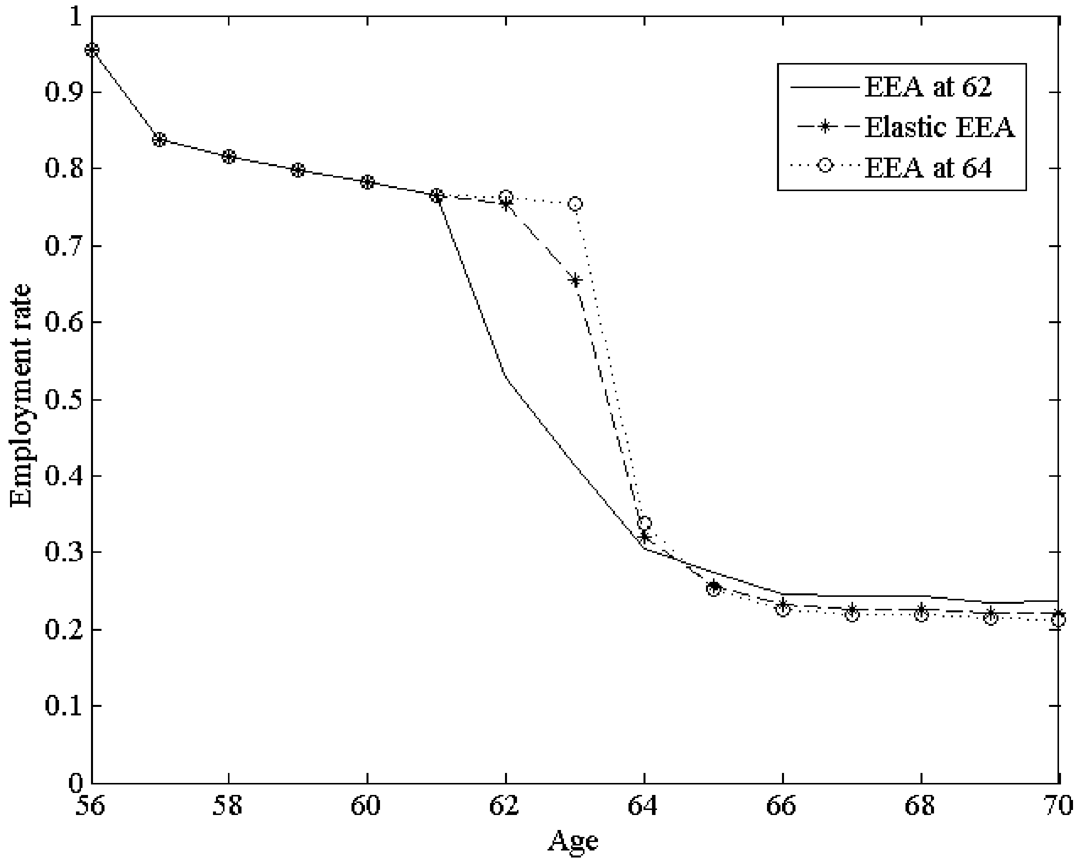

Figure 3: Percent Working by Age: Simulations.

suggests that an Elastic EEA would achieve its goal in encouraging longer working lives nearly as well as would setting the EEA at age 64. Interestingly, a slightly large share of older workers would prefer to retire after age 65 under any new policy rule compared to the status quo. A higher level of retirement benefits due to later claiming ages could explain lower employment rates in later years.

4.3 The Claiming Decision

Figure 4 shows the effect of raising the EEA on the claiming decision of older workers using different policy rules. We would expect to see workers who were forced to postpone the claiming decision to claim as soon as benefits are available. Indeed, the percent of people claiming at age 64 would jump from 13 to 66 percent if the EEA is raised to age 64 for everyone. However, not everyone who is eligible to claim benefits at age 62 under the Elastic EEA would do so. According to the simulation, 26 percent of people would have their EEA set at age 62 and 25 percent at age 63.[12] Only nine percent of older workers claim benefits at age 62 and 16 percent at age 63 under the Elastic EEA.[13] Thus, this simulation supports a common perception that low-income people who are able to work do postpone the claiming decision, while those in poor health or unable to find employment are forced to claim as soon as benefits become available. Raising the EEA to age 64 for everybody would hurt these nine percent of workers who would claim at 62 and 16 percent that would claim at 63 under an Elastic EEA. Thus, this simulation suggests that an Elastic EEA would achieve its goal in protecting the most vulnerable workers who cannot continue to work.

[12]Simulation eligibility numbers are slightly different from those of Table 3 due to discretization of the Average Indexed Earnings (AIE) state variable. In addition, the Elastic EEA is proposed to be calculated on a monthly basis, while the dynamic model calculates EEA on an annual basis.

[13]Characteristics of simulated agents by claiming status show that all of the 9 percent of people who decide claim at age 62 under the Elastic EEA have poor health.

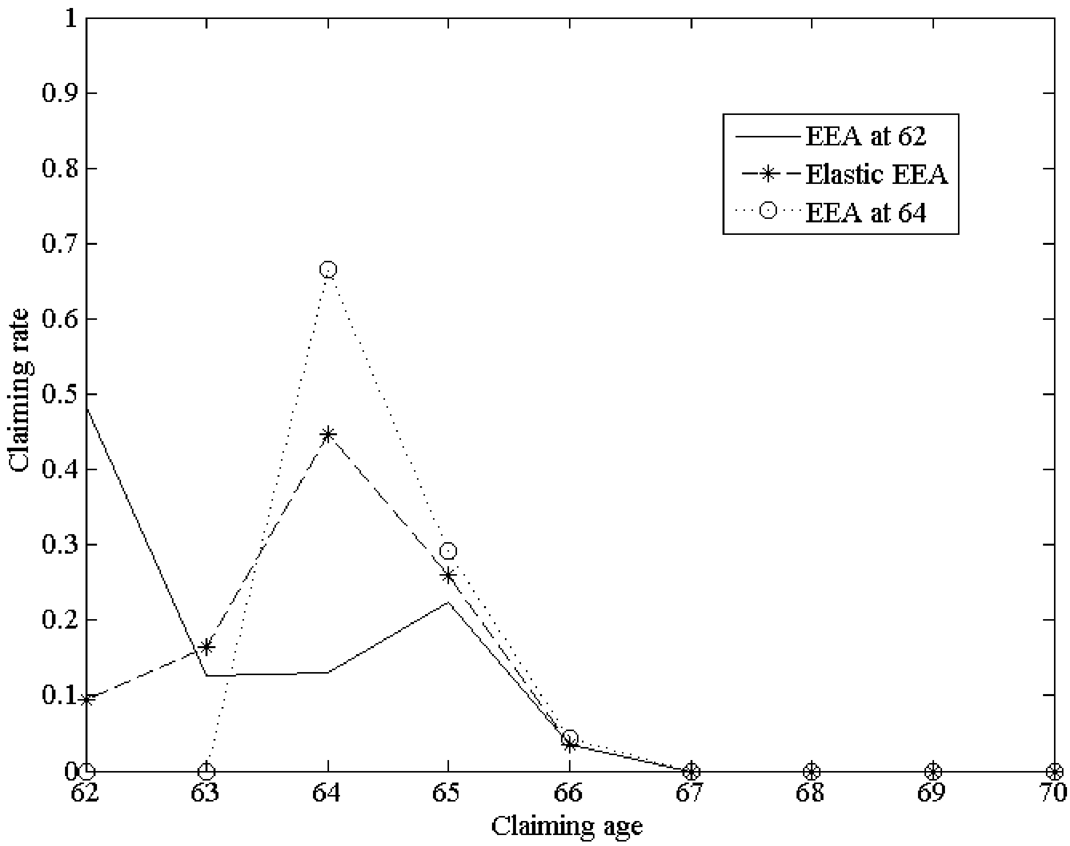

Figure 4: Claiming Age: Simulations.

4.4 Welfare Analysis

The idea behind raising the EEA is to prevent people from claiming reduced benefits and to increase the overall level of consumption by claiming full rather than actuarially reduced retirement benefits and staying longer in the labor force. However, since the proposed policy rules are more restrictive than the status quo, workers are expected to experience a decline in their level of utility at some ages and an increase at others.

Figure 5 shows the effect of raising the EEA on the level of retirement benefits under different policy rules. Under the status quo the average level of retirement benefits is about $10,000, which is consistent with the average level of benefits reported by the Social Security Administration in 1998.[14] Setting the EEA at age 64 produces a higher average level of retirement benefits by about ten percent at age 66 compared to the status quo. Allowing low life-time earners to claim benefits at age 62 under the Elastic EEA would produce an average level of retirement benefits that is about seven percent higher that we observed in 1998.

Figure 6 shows the effect of raising the EEA on the overall level of consumption under different policy rules. The overall level of consumption is higher due to a higher level of retirement benefits. In addition, the average level of consumption is higher for workers in their early 60s as they stay employed and receive income from work. Thus, this simulation suggests that an Elastic EEA would achieve its goal in providing a higher level of consumption in the economy compared to the status quo.

Figure 7 shows the effect of raising the EEA on the current level of utility under different policy rules. The average level of utility is declining until workers become eligible for Social Security retirement benefits. Although older workers would prefer to retire early, they are

[14] According to SSA (2005), average monthly benefit for 1998 was $780, which amounts to $9,360 a year.

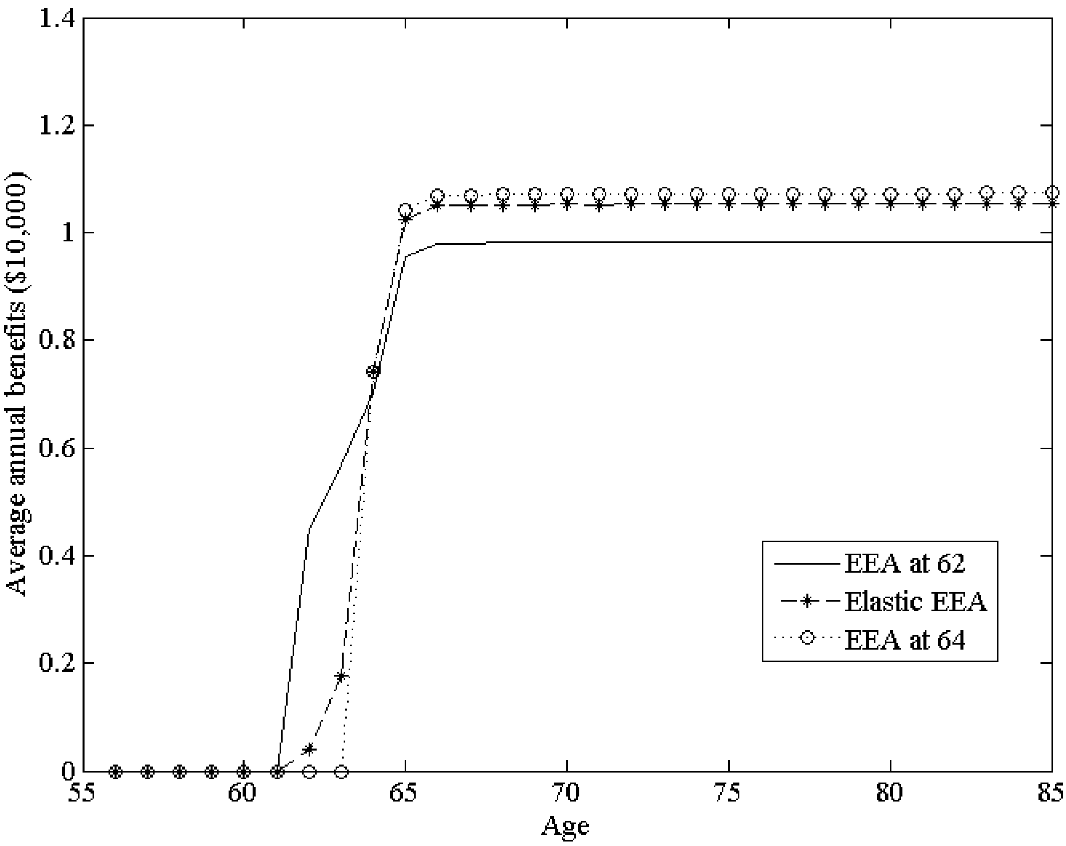

Figure 5: Level of Retirement Benefits: Simulation.

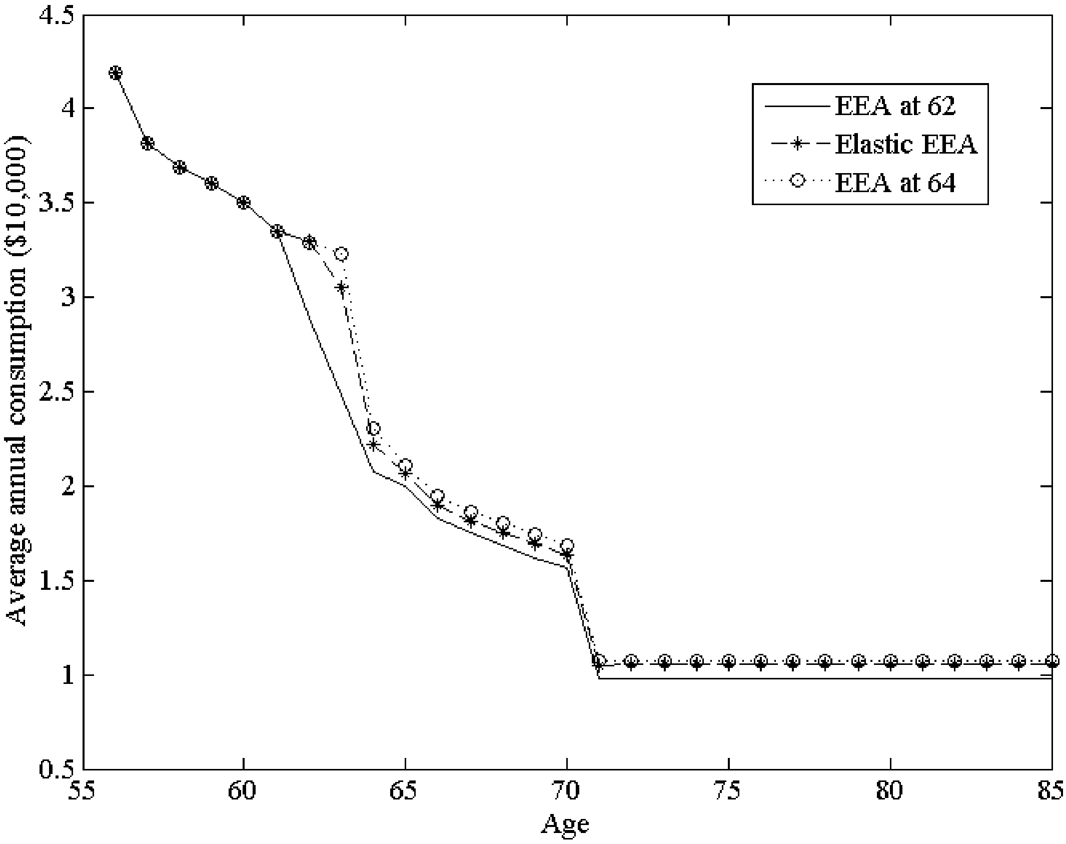

Figure 6: Current Level of Consumption: Simulation.

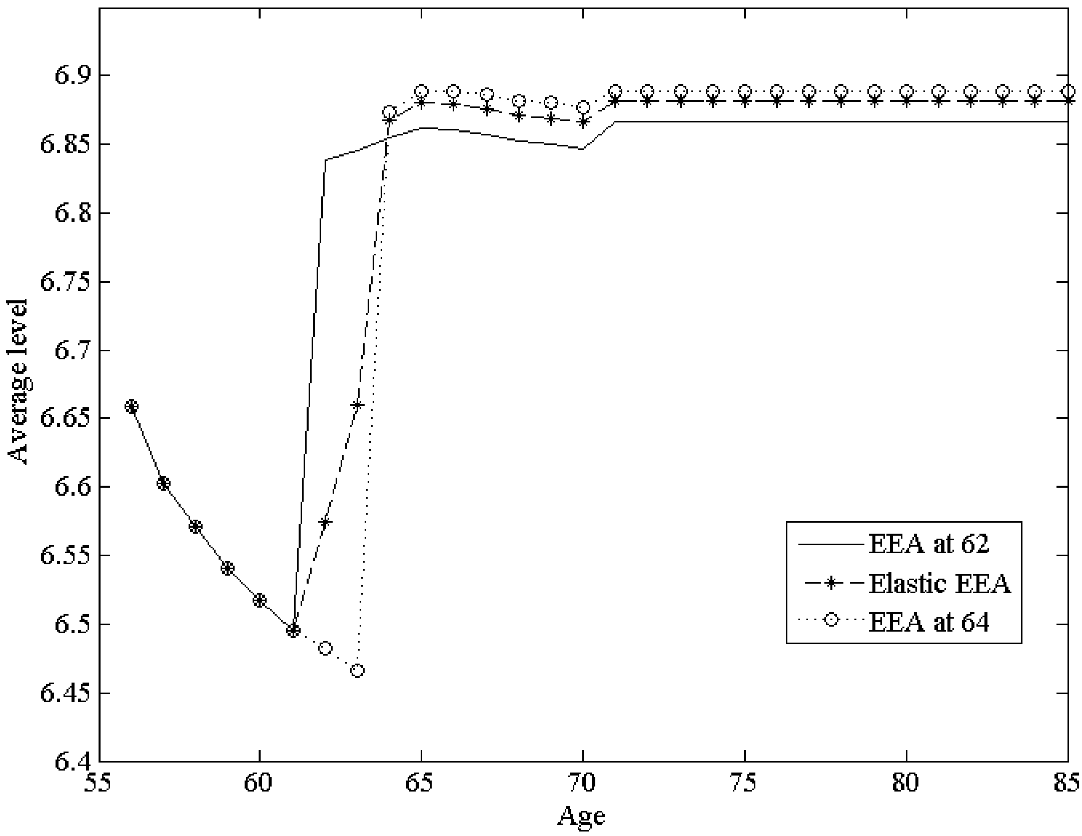

Figure 7: Current Level of Utility: Simulation.

unable to borrow against future Social Security benefits and must wait until they are eligible. Thus, this figure illustrates the explanation for the peak in retirement at age 62. As the proposed policy rules force older workers to postpone their claiming decision, their level of consumption and level of utility is higher during their retirement years compared to the status quo. Thus, this simulation suggests that an Elastic EEA would achieve its goal in providing a higher level of utility in retirement years compared to the status quo.

Figure 7 also demonstrates that an Elastic EEA would adversely affect the level of utility during workers' early 60s to lesser extend compared to the EEA at age 64.

4.5 Fiscal Impact and Poverty

The purpose of raising the EEA is to assure retirees a more adequate guaranteed monthly income. Because Social Security benefits are actuarially adjusted, raising the EEA would achieve that objective with little direct increase in program costs.[15] An elastic EEA would result in a modest increase in the cost of providing Social Security retirement benefits.[16] However, an across-the-board increase in the EEA can be expected to increase other government expenditures. As shown in Table 3, 24 percent of low life-time earners have applied for DI or SSI benefits at some point in their lives. Requiring such workers to wait to 64 to access Social Security retirement benefits can be expected to result in increased government expenditures on such "safety-net" programs. It is far from clear whether these increased expenditures, over the long-term, would be greater or less than the increased expenditures

[15]Raising the EEA would increase program costs to the extent that it increased survivor benefits, which are not factored into the actuarial adjustment. On the other hand, raising the EEA would improve Social Security's cash flow by postponing benefit payments.

[16]Costs would rise under an elastic EEA because low earners, with a relatively low life expectancy, would not have their lifetime benefits reduced via a shortened period of benefit receipt, while the lifetime benefits of high earners would rise, due to their relatively long life expectancy, as their higher monthly benefits more than offset the shortened period of benefit receipt. The increase would be modest because the change in the value of lifetime benefits for low earners relative to high earners resulting from an increase in the EEA, as pointed out above, is small.

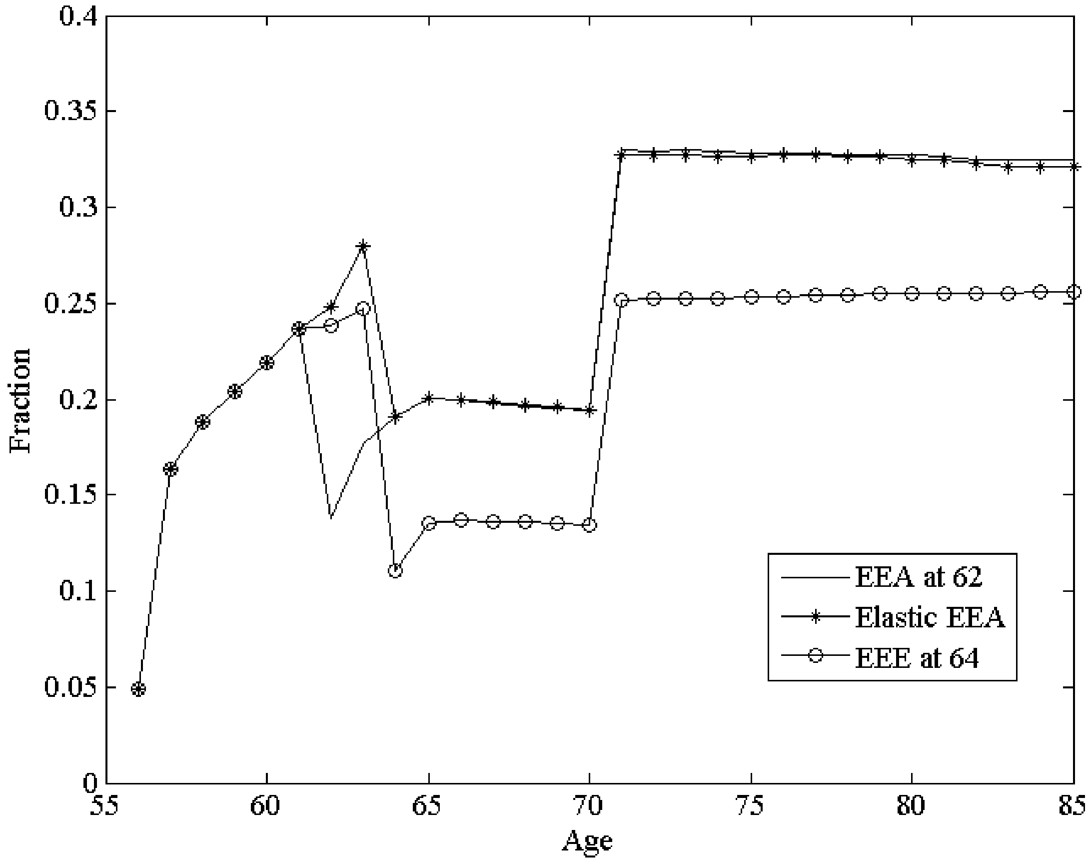

Figure 8: Poverty rates: Simulation.

on an elastic EEA.[17]

Figure 8 shows the effect of raising the EEA on the number of potential federal aid recipients under different policy rules. The percent of people below the poverty level is calculated to determine the adverse effect of each policy and address the most important critique of raising the EEA. The simulation overstates the percent of people below the poverty level as the model considers only income from earnings and individuals' own Social Security benefits, ignoring other sources of income, such as Social Security benefits of the spouse. As the poverty threshold for a couple is only slightly higher the threshold for a single individual, adding spousal retirement benefits would produce lower poverty rates.[18] Interestingly, the profile of the poverty rate by age is consistent with data reported by the U.S. Census Bureau (1999) — poverty rates are high for individuals in their late 50s and early 60s, falling for individuals in their mid to late 60s, and rising after that.

This result exposes the limitations of all of the existing structural models analyzing retirement behavior. Setting the EEA at age 64 produces the lowest poverty rates, which is contradictory to the common perception. The reason behind such an inconsistency between the model and real data is the assumption that all individuals have the same probabilities of losing and finding a job. However, low-income and older individuals tend to have poorer job opportunities relative to high income and prime-age individuals. According to the U.S.

[17]While an elastic EEA could protect at-risk workers from hardships associated with delayed eligibility, it would not protect such workers from the meager benefits paid to low-wage workers at age 62. An option that would address this concern would be to fix the EEA benefit at 80 percent of the FRA benefit. This would clearly increase program costs and worsen Social Security's long-term financing shortfall. On the other hand, it would reduce the incentive to claim Disability Insurance benefits. The monthly DI benefit is the worker's monthly FRA benefit. When the FRA is 67, the DI benefit will be 43 percent higher than the age-62 retirement benefit, but it would be only 25 percent higher if the EEA benefit were fixed at 80 percent of the FRA benefit. Fixing the EEA benefit would also "flatten" the Social Security program, making benefits claimed prior to the FRA less sensitive to average lifetime earnings. This could be valuable as policymakers seek ways to close Social Security's financing shortfall by cutting benefits while preserving a minimal level of benefit adequacy.

[18]The poverty threshold was about $8,000 for a single individual and $10,000 for a couple. Since wives receive at least 50 percent of the husband's benefit, the model would produce lower poverty rates if spousal benefits are considered. The actual poverty rate for those 65 and older was about 10 percent over the last 10 years (http://www.census.gov/hhes/www/poverty/histpov/perindex.html).

Department of Labor (1998), the unemployment rate in 1998 was 7.1 percent for those with less than a high school degree, four percent for high school graduates, and only 1.8 percent for college graduates. A forthcoming study by Munnell et al. (2008) shows that older workers have a higher displacement rate relative to prime-age workers. Thus, current structural retirement models estimating the effect of raising the EEA to age 64 ignore the fact that older and low-income individuals have poor job opportunities and thus underestimate the adverse effect of raising the EEA.

By allowing low life-time earners to claim Social Security benefits at an earlier age, an Elastic EEA would produce the same level of poverty in retirement as the current policy rule produces. Regardless of any EEA policy rule, the only way to help low life-time earners is to expand other public programs that would provide some minimum level of benefits. As Table 1 shows, a low earner would receive only 80 percent of the poverty line even if they postpone the claiming decision until age 64. As the current model does not allow for a saving decision, the poverty rates at ages 62 and 63 are the highest under the Elastic EEA, as high life-time earners in poor health chose to retire and consume the minimum guaranteed level of income without access to their private savings. Adding a saving decision to the model presented in Zhivan (2008) would reduce the poverty rates at these ages. The assumption of equal job opportunities for all workers prevents from properly analyzing the advantages of Elastic EEA in protecting the most vulnerable population compared to a fixed EEA at age 64.

5 Conclusion

As national retirement income contracts and life expectancy increases, raising the Earliest Eligibility Age is an inevitable step toward encouraging longer working lives. The question is can we do so in a way that minimizes the negative effects on the most vulnerable population? Raising the EEA to age 64 would create hardship among workers with low private savings who are unable to work or find employment until the higher eligibility age. This study suggests that tying the individual's EEA to their Average Indexed Earnings is a feasible policy rule that would encourage longer working lives while protecting the most vulnerable population. While an Elastic EEA should be complemented with public assistance programs that would address inadequacy of retirement income of those claiming early, tying the EEA to AIE is a better alternative than raising the EEA to 64 for two reasons. First, income of those who claim early could be boosted under the Elastic EEA rather than replaced under the EEA at 64 before workers are eligible to receive the Social Security benefits. Second, some low-income individuals would prefer to claim own reduced benefits under the Elastic EEA rather than apply for welfare benefits under the EEA at age 64 due to stigma associated with relying on public assistance.[19]

Simulations based on the model by Zhivan (2008b) suggest that an Elastic EEA would 1) postpone the claiming decision for the majority of workers; 2) increase the average level of benefits, consumption, and utility during their retirement years; and 3) allow vulnerable workers to claim benefits early. Simulations also demonstrate the limitation of existing structural retirement models' estimates of the effect of raising the EEA. Models assuming the same probabilities of losing and finding a job for all individuals underestimate the adverse effect of raising the EEA on the most vulnerable population. Thus, modeling heterogeneity in job opportunities is an essential part of evaluating the distributional aspect of any EEA policy rule. Unfortunately, differences in labor market demand for workers with different earnings potentials are not well documented.

[19] One way to boost reduced Social Security benefits under an Elastic EEA is to apply less than actuarially fair adjustments for low-income individuals. Since low-income individuals tend to have low life expectancy, this approach should have a modest effect on the costs of the program.

References

[1] Centers for Disease Control. 2007. Available at: http://www.cdc.gov/nchs/data/nvsr/nvsr54/.

[2] Cowen, Tyler. 2008. “Means Testing, for Medicare.” The New York Times. July 20.

[3] Favreault, Melissa M., and Eugene Steuerle. 2008. “The Implications of Career Lengths for Social Security.” *CRR Working Paper* 2008-5. Chestnut Hill, MA: Center for Retirement Research at Boston College.

[4] Favreault, Melissa M., Gordon B. T. Mermin, and C. Eugene Steuerle. 2006. “Minimum Benefits in Social Security.” Washington, DC: AARP Public Policy Institute.

[5] Gustman, Alan L. and Thomas L. Steinmeier. 2005. “The Social Security Early Entitlement Age in a Structural Model of Retirement and Wealth.” *Journal of Public Economics* 89(2-3), pp.441–463.

[6] Haverstick, Kelly, Sapozhnikov, Margarita, Triest, Robert, and Natalia Zhivan. 2007. “A New Approach to Raising Social Security Earliest Eligibility Age.” *CRR Working Paper* 2007-19. Chestnut Hill, MA: Center for Retirement Research at Boston College.

[7] Lundberg, Shelly and Jennifer Ward-Batts. 2000. “Saving for Retirement: Household Bargaining and Household Net Worth.” *Working Paper* 2000-004. Michigan Retirement Research Center.

[8] Mosisa, Abraham and Steven Hipple. 2006. “Trends in Labor Force Participation in the United States.” *Monthly Labor Review* 129(10), pp.35-57.

[9] Munnell, Alicia H., Kevin B. Meme, Natalia A. Jivan, and Kevin E. Cahill. 2004. “Should We Raise Social Security’s Earliest Eligibility Age?” *Issue in Brief* 18. Chestnut Hill, MA: Center for Retirement Research at Boston College.

[10] Munnell, Alicia H., Steven Sass, Mauricio Soto, and Natalia A. Zhivan. 2008. “Has the Displacement of Older Workers Increased?” *CRR Working Paper* 2008-17. Chestnut Hill, MA: Center for Retirement Research at Boston College.

[11] Munnell, Alicia H., and Steve Sass. 2008. “Working Longer: The Solution to the Retirement Income Challenge.” Washington, DC: Brookings Institution Press.

[12] Rogot, Eugene, Sorlie, Paul, and Norman Johnson. 1992. “Life Expectancy by Employment Status, Income, and Education in the National Longitudinal Mortality Study.” *Public Health Rep* 107(4), pp.457-461.

[13] Samwick, Andrew A. 1998. “New Evidence on Pensions, Social Security, and the Timing of Retirement.” *Journal of Public Economics* 70(2), pp.207-236.

[14] Sass, Steven A., Wei Sun, and Anthony Webb. 2007. "Why Do Married Men Claim Social Security Benefits So Early? Ignorance or Caddishness?" *Issue in Brief* 8-4. Chestnut Hill, MA: Center for Retirement Research at Boston College.

[15] Song, Jae, and Joyce Manchester. 2008. "Have People Delayed Claiming Retirement Benefits? Responses to Changes in Social Security Rules." *CBO Working Paper* 2008-04, U.S. Congressional Budget Office.

[16] Sullivan, Daniel G. Till von Wachter, 2006. "Mortality, Mass-layoffs, and Career Outcomes: an Analysis Using Administrative Data." *Working Paper Series* WP-06-21, Federal Reserve Bank of Chicago.

[17] U.S. Census Bureau. 1999. Official Poverty Tables. Table 23.

[18] U.S. Department of Labor. 1998. Labor Force Statistics. Available at: ftp://ftp.bls.gov/pub/special.requests/lf/aa98/AAT7.TXT

[19] U.S. Social Security Administration. 2006. "Income of the Aged Chartbook, 2004." Office of Research, Evaluation, and Statistics.

[20] U.S. Social Security Administration. 2005. Annual Statistical Supplement. Table 5.B8.

[21] Zhivan, Natalia A., Sass, Steven S., Sapozhnikov, Margarita, and Kelly Haverstick. 2008. "An "Elastic" Earliest Eligibility Age for Social Security." *Issue in Brief* 8-2. Chestnut Hill, MA: Center for Retirement Research at Boston College.

Has the Displacement of Older Workers Increased?

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Abstract

Conventional wisdom says older workers are less likely to be displaced. However, the difference in displacement rates between younger and older workers disappeared in the 2006 Displaced Worker Survey (DWS). The increased vulnerability of older workers appears to be the reason for this convergence. This is troublesome, as continued employment of older workers is increasingly critical to their ability to gain a secure retirement, given a contracting retirement income system and increased life expectancy. To better understand the age-displacement relationship, this study takes advantage of the availability of job tenure information and consistent design of the DWS since 1996. Using a Blinder–Oaxaca decomposition, it analyzes the effect of changes in tenure, industry mix, and educational attainment on the displacement rates of younger and older workers. The results show that older workers are now more likely to be displaced than prime-age workers, conditional on education, manufacturing industry, and tenure. The results also show that declining tenure, a weakened relationship between educational attainment and displacement, and a higher incidence of displacement in manufacturing for older workers were important contributors to the convergence of displacement rates of older and younger workers. The results also suggest an explanation for the puzzling stability of the overall displacement rate in the world of declining tenure. The upward pressure on overall displacement risk, created by declining tenure, was largely offset by the declining share of employment in manufacturing industries with unusually high dislocation rates.

JEL Classification Codes: J14, J23, J26, J63, J70

Keywords: displacement, older workers, tenure

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1 Introduction

Conventional wisdom says that older workers are less likely to be displaced than younger workers. However, the difference in displacement rates between younger and older workers has disappeared, according to the 2006 Displaced Worker Survey (Figure 1), and the increased vulnerability of older workers seems to be the reason. The question is what might explain such changes in the relative displacement rates of older and younger workers. Changes in tenure, industry mix, and educational attainment are likely explanations.[1] This paper provides a descriptive analysis that explores the relationship between job loss, age, and these three explanatory factors over the period 1996-2006 using the biennial Displaced Worker Supplement (DWS) to the Current Population Survey (CPS).[2]

Displacement, while painful for all workers, is especially challenging for older workers. Older workers who are displaced are less likely to be reemployed, have less time to adjust their retirement plans, and are more likely to retire prematurely. With a contracting retirement income system[3] and increased life expectancy, the continued employment of older workers is also increasingly critical to their ability to ensure a secure retirement.

Previously, researchers presumed that tenure, not age per se, protected older workers from

[1]The shift in the nature of pension coverage could affect the displacement rate of older workers as well. The shift from defined benefit to defined contribution pensions makes older workers more attractive for employers. The lack of data prevents further investigation of the relationship between pension type and displacement.

[2]The data reported below come from the 1984-2004 Displaced Worker Supplements (DWSs), which were conducted as part of the January Current Population Survey in 1984, 1986, 1988, 1992, 2002, 2004, and 2006 and the February CPSs in 1994, 1996, 1998, and 2000. There have been changes in the design of the survey, such as change in recall period in 1992 and wording in 1994. Following the now-standard approach in the literature, in our sample we consider displaced only those who lost their jobs for the following three reasons: plant closing, insufficient work, and position or shift was abolished.

[3]The Full Retirement Age (FRA) when the full retirement benefits are available is rising from age 65 to 67, which is analogous to a cut in benefits at each point in time. In addition, the nature of private pension plans has changed from being predominantly defined benefits plans to being predominantly defined contribution plans. Munnell and Sass (2008) show that workers save less with defined contribution compared to defined benefit pension plans.

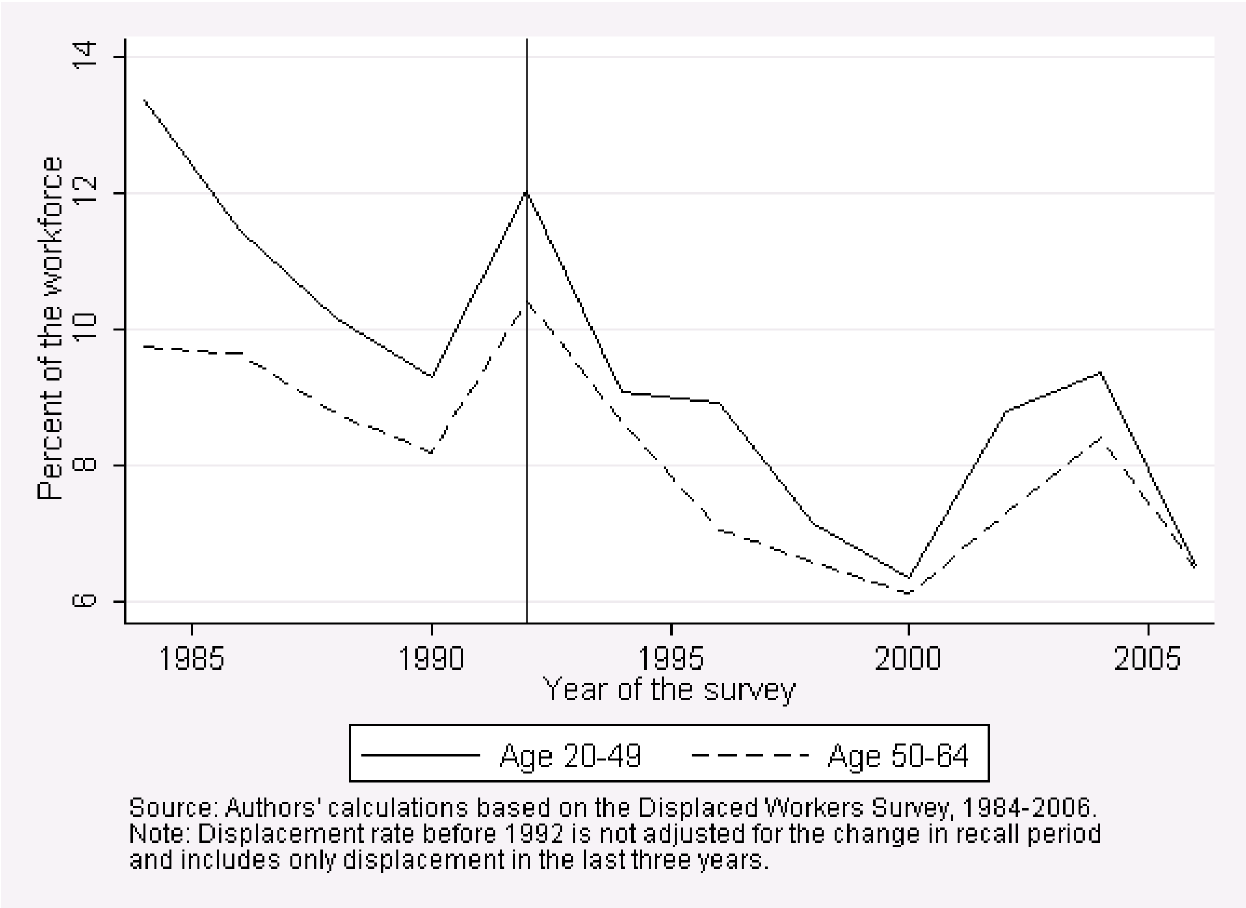

Figure 1: Displacement Rates by Age, CPS 1984-2006.

displacement (Farber (1997), (2003), and (2005), Rodriguez and Zavodny (2000)). However, lack of data on job tenure prevented researchers from exploring the age-displacement and tenure-displacement relationships. If tenure is a sufficient explanation of the lower rate of job displacement among older workers, it is also puzzling that displacement has not increased until recently, given that job tenure has noticeably declined over the last 30 years (Munnell and Sass (2008), Farber (2006), Munnell et al. (2006)). Rodriguez and Zavodny (2000) have analyzed the effect of rising educational attainment and changing industry mix on the displacement of older workers between 1983-1987 and 1993-1997. They found that improved educational attainment and the shift from goods producing to service producing jobs have reduced displacement. However, since manufacturing jobs tend to be long tenured, the estimated effect of the change in industry mix may be biased due to lack of data on tenure. Furthermore, the change in the design of the DWS in 1994 may have obscured key relationships in previous analyses of the displacement trends (Farber (1997, 2003, 2005), Rodriguez and Zavodny (2000)).[4]

This study builds on the work of Rodriguez and Zavodny (2000) and Farber (2005) by analyzing the effect of changes in tenure, industry mix, and educational attainment on the displacement of older workers. The study takes advantage of the availability of job tenure information for all workers and the consistent design of the DWS between 1996 and 2006. Using a Blinder–Oaxaca decomposition, the study analyzes the effect of changes in tenure, educational attainment, and manufacturing's share of employment—and changes in the effect of these factors—on the overall displacement rate and on the displacement rates of older and prime-age workers (workers aged 50-64 and 35-49, respectively). Some earlier studies compared older workers with workers in their twenties and early thirties. As such workers cannot accumulate tenure comparable to older workers (see the Appendix for the

[4]Katharine Abraham in her comments to Farber (1997a) discuses some of the limitations of the corrections of the DWSs. See Farber (1997a) pp.135-141 for more details.

distribution of tenure by age), the effects of tenure and age cannot be separately identified in such specifications.[5]

Comparing older and prime-age workers, the analysis finds that at the beginning of the 10-year period the two groups had the same probability of job loss, controlling for industry, tenure, and educational attainment, but older workers are now more likely to be displaced.[6] The increased educational attainment of older workers relative to prime-age workers did not provide them with greater security due to the fading relationship between education and displacement. Declining tenure, a weakened relationship between educational attainment and displacement, and a higher incidence of displacement in manufacturing for older workers were important contributors to the convergence of displacement rates of older and younger workers.

Changes in the design of the DWS prevent a similar decomposition of dislocation prior to 1993, when changes in educational attainment, industry mix, and tenure were much larger. Due to the short time span and small changes observed in tenure, educational attainment, and industry mix, these findings are more suggestive than conclusive. However, this study suggests that a solution to the puzzle—why dislocation rates have been relatively stable while tenure has declined—appears to be the decline in the share of employment in manufacturing.

These findings have two main implications. First, labor demand may help explain lower labor force participation rates among workers approaching retirement relative to prime-age workers. The fact that older workers are now more likely to be displaced than prime-age workers, controlling for tenure, education, and other demographic characteristics, suggests that older workers are discriminated against in the labor market. While discrimination of older workers has been difficult to test empirically, the common perception of discrimination

[5]Previous studies, such as Rodriguez and Zavodny (2000) and Farber (1993), use 20 year olds as the omitted group.

[6]The changes in unobserved characteristics of older workers could explain the raise in the displacement rates of older workers as well. Thus, the types of jobs that older workers choose may change over time and cause a higher rate of displacement rather than declining demand for older workers.

is if anything more true today than in the past.[7] Second, structural models of labor market behavior should differentiate between prime-age and older workers when modeling the probability of job loss. In such models, the higher share of non-employed older workers is thus attributed to preferences—such as the rising utility of leisure with age—rather than higher displacement rates or other labor demand considerations.

The paper proceeds as follows. Section 2 documents new trends in the displacement of older workers and offers explanations for the observed trends. Section 3 provides descriptive regression analysis of the displacement and a Blinder–Oaxaca decomposition to assess the importance of changes in education, industry mix, and job tenure and changes in their effects on the displacement of older and prime-age workers. Section 4 concludes.

2 Factors Influencing Displacement of Older Workers

Previous research has identified tenure, industry mix, and educational attainment, all of which have changed over the last 20 years, as factors that affect the risk of displacement:

- *Job Tenure.* One reason why older workers were thought to have lower displacement rates than younger workers is because they generally have longer job tenure and, as a result, have accumulated more firm-specific human capital (Becker (1975)). Employers would be reluctant to lay off older workers because they would lose firm-specific human capital and would be forced to train new workers. Farber (2006) documents a significant decline in long-term employment relationships, especially for older workers, narrowing the gap in tenure between younger and older workers. Data from the Mobility Supplement of the CPS show that the median tenure of workers age 50-64 has fallen

[7] Another explanation for higher probability of displacement is the type of jobs older workers choose that we do not observe.

from a high of 13 years in 1983 to 10 years in 2006 while median tenure for 35-49 year old workers has declined from 7 to 5 years (see Table 1).[8] While a secular decline in long-term employment relationships should increase the overall displacement rate, the declining tenure gap could explain why older workers, relative to prime-age workers, became more vulnerable to displacement.

- *Share of Jobs in Manufacturing.* Manufacturing has a displacement rate twice as high as the rest of the economy (Kletzer (1998)). Thus the overall displacement rate should have declined with the declining share of jobs in manufacturing, from about 23 percent of employment in 1984 to 13 percent in 2006 (see Table 1). This decline in manufacturing could also increase the dislocation rate of older relative to younger workers as older workers tend to be concentrated in declining industries. Manufacturing jobs also tend to be long-tenured jobs. So the shift from manufacturing to services-producing industries may also have contributed to the decline in tenure.

- *Educational Attainment.* Between 1984 and 2006, the educational attainment of older workers improved dramatically. The percentage of those 50-64 with a bachelor's degree or higher has doubled (see Table 1). More importantly, even though the educational attainment of each cohort traditionally surpassed that of earlier cohorts, the discrepancy between the educational attainment of older and younger cohorts has essentially disappeared. Older workers now look very much like younger workers in terms of educational attainment. Since displacement rates decline as educational attainment rises, the rising attainment of older workers should reduce their displacement rate and the elimination of the gap in educational attainment should have increased the gap in displacement rates between younger and older workers.

[8] Average tenure has sharply decreased over time for men, while that for women has increased slightly. On balance, however, overall combined tenure has declined.

3 Changes in Worker Characteristics and Their Effects on Displacement Risk

To analyze trends in the relationships between workers' characteristics and displacement over time, this study first estimates a linear probability model of displacement in 1993-1997, 1997-2001, and 2001-2005 samples corresponding to 1996-1998, 2000-2002, and 2004-2006 DWSs respectively. The result of this exercise produces coefficients that give the effect of these characteristics in these three periods. Using a Blinder–Oaxaca decomposition, this study then estimates the net effect of the changes in tenure, educational attainment, and industry mix on the overall displacement rate and on the displacement rate of older and prime-age workers. As each of the three periods analyzed include periods of growth and of recession, the displacement experience in each does not reflect unique cyclical conditions.[9]

This study takes advantage of the addition of job tenure information in DWS from 1996 to 2006, which gives information about displacement from 1993 to 2005. While the DWS has been conducted since 1984, changes in the survey design before 1996 impede the analysis of trends prior to that year. Unfortunately, most of the sizable changes in educational attainment, industry mix, and tenure occurred before 1996. For example, the share of workers aged 35-49 in manufacturing dropped from 22 to 13 percent from 1984 to 2006, with only 4 percentage points of this decline occurring between 1993-1997 and 2001-2005. The percent of high school drop-outs in the population aged 50-64 has fallen from 33 to 13 percent, with only 7 percentage points of this decline occurring between 1993-1997 and 2001-2005.[10] However, the availability of tenure data and the consistency in the recall period

[9] Period 1993-1997 corresponds to 1996-1998 DWSs, 1997-2001 and 2001-2005 correspond to 2000-2002 and 2004-2006 DWSs respectively. We combined periods of growth and recession, so that the overall displacement rate is about the same across years. Note that the total displacement rate for 1993-1997 was 8.5 percent, 1997-2001 was 8.1, and 2001-2005 was 8.6.

[10] Note that characteristics from Table 1 may not correspond to characteristics in Table 8 as Table 1

and survey wording justify a focus on the abbreviated time period.

3.1 Changing Relationships between Characteristics and Displacement

We estimated the following linear probability models of displacement[11] in 1993-1997, 1997-2001, and 2001-2005 (Table 2):

$$y_{it} = x_{it}\beta_t + \phi_t + \epsilon_{it} \tag{1}$$

where y_{it} is a dummy variable that takes value 1 if the individual i is displaced in the last three years prior to the survey at time t for reasons of plant closure, position abolished, or slack work and zero otherwise, x_{it} is a set of characteristics of the individual i in the period t, ϕ_t is a year fixed effect, and ϵ_{it} is an identically distributed idiosyncratic shock with zero mean. Due to the cross-sectional nature of the data, we make the strong assumption that unobserved characteristics of individuals conditional on observed characteristics have zero expected value.

Regression results for the initial 1993-1997 period, as we would expect, show college graduates, public sector workers, and workers with long job tenure are less likely to be

is based on the March Supplement and Table 8 is based on the January Supplement to the CPS. The January Supplement is representative of the workforce rather than the overall population. While Table 1 is constructed to demonstrate trends in population, Table 8 facilitates a Blinder–Oaxaca decomposition.

[11] A binomial probit model is more appropriate to estimate the probability of being displaced than the linear probability model since estimates of the linear probability model can predict probabilities that are greater than one and below zero and error terms of the linear probability model are heteroskedastic. However, we use estimates of the linear probability model to perform a Blinder–Oaxaca decomposition. A linear probability model allows estimating the independent contribution of each characteristic to the change in the displacement rate in a Blinder–Oaxaca decomposition, while the contribution of each characteristic in a probit model depends on the distribution of other characteristics. While the assumption of the independence of each characteristic's contribution is somewhat unrealistic, it eliminates the need to fix the distribution of other characteristics at some particular values.

displaced than workers with lower levels of educational attainment, individuals working in the private sector, and workers with shorter tenure (Table 2). Additionally, workers in manufacturing faced a higher likelihood of displacement than workers in other industries. Conditional on tenure, the results also show that older workers and prime-age workers had the same probability of job loss (see Appendix for the results without controls for tenure). All of these relationships are statistically significant.

Regression results for the later periods indicate a change in the relationship between certain characteristics and the probability of displacement. While a college degree continued to shield workers from displacement, the negative correlation between displacement and educational attainment declined. Between 1993-1997 and 2001-2005, the difference in the likelihood of displacement between college and high school graduates dropped from 1.8 to 0.9 percentage points. Workers in manufacturing, on the other hand, have become more vulnerable over time. Their increased likelihood of displacement, relative to workers in other industries, has risen from 2.1 to 6.7 percentage points. The effect of tenure on displacement has not changed over time despite the declining number of long-tenured jobs. Finally, older workers were more likely to be displaced, controlling for education, tenure, manufacturing industry, and public sector. While older and prime-age workers had essentially the same likelihood of displacement in 1993-1997, their risk of displacement increased in subsequent periods.

Table 3 shows regression results for prime-age and older workers separately. Regression results of the displacement model for older and prime-age workers demonstrate the same trends with one exception: college graduates are not shielded from displacement within either group, conditional on tenure and manufacturing industry (Table 3).[12] This finding

[12] We tried different specifications of the probability model of displacement. Models that did not control for industry and public sector produced statistically significant negative relationships between being a college graduate and displacement. Inclusion of manufacturing and public sector variables gave a statistically insignificant relationship between having college degree and displacement, as we observe in Table 3. Indeed, the public sector tends to have a high concentration of college graduates and is associated with very low

contradicts the conventional wisdom that educational attainment shields workers from displacement and that rising educational attainment would reduce displacement risks. One possible explanation is that accumulated firm-specific human capital is more valuable than generic human capital at this stage of people's careers, at least in terms of protection against displacement. In addition, the results show that older workers have a higher increased risk of displacement in manufacturing compared to prime-age workers: 8.5 versus 6.5 percentage points higher than workers in non-manufacturing private sector industries. Interestingly, the effect of tenure in reducing displacement became somewhat stronger for prime-age workers while showing little change for older workers with more than five years of tenure. For older workers with less than one year of tenure, however, the risk of displacement has risen.

3.2 Blinder–Oaxaca Decomposition of the Change in the Incidence of Displacement

The regression results presented in the previous section show how the relationship between certain worker characteristics and the probability of displacement changed among older and prime-age workers. The analysis, however, ignores changes between 1993-1997 and 2001-2005 in the characteristics of the workforce. This section presents the results of a Blinder–Oaxaca decomposition to estimate the separate and combined effects of the change in worker characteristics and the above-estimated change in the effects of these characteristics on displacement: that is, the separate and combined effects of the change in the means and the change in the coefficients of the explanatory variables.

Using the Blinder–Oaxaca decomposition, the change in the displacement rate is written as follows:

displacement rate, while the declining manufacturing sector tends to employ workers with high school degree and has a displacement rate twice as high as the rest of the economy (Kletzer (1998)).

$$\bar{Y}_{01-05} - \bar{Y}_{93-97} = \left[\bar{X}_{01-05} - \bar{X}_{93-97}\right]\hat{\beta}_{01-05} + \bar{X}_{01-05}\left[\hat{\beta}_{01-05} - \hat{\beta}_{93-97}\right] + \left[\bar{X}_{01-05} - \bar{X}_{93-97}\right]\left[\hat{\beta}_{93-97} - \hat{\beta}_{01-05}\right] \quad (2)$$

where $\bar{Y}_{01-05} - \bar{Y}_{93-97}$ is the difference in the displacement rate between 2001-2005 and 1993-1997. The first right-hand term, $\left[\bar{X}_{01-05} - \bar{X}_{93-97}\right]\hat{\beta}_{01-05}$, the so-called "endowment effect," estimates the effect of the change in workers' characteristics on the change in the displacement rate. It gives the hypothetical change in the displacement rate had the workforce in 2001-2005 had the characteristics of the workforce in 1993-1997. The second term, $\bar{X}_{01-05}\left[\hat{\beta}_{01-05} - \hat{\beta}_{93-97}\right]$, estimates the effect of changes in the coefficients produced by the regressions discussed in the previous section; it gives the hypothetical change in the displacement rate in 2001-2005 had relationships between displacement and workforce characteristics in 2001-2005 been the same as in 1993-1997. $\bar{X}_{01-05}\left[\hat{\beta}_{01-05} - \hat{\beta}_{93-97}\right]$ also captures the effect of differences in unobserved characteristics, for example, the types of jobs that older workers held in 2001-2005 may be different from the types of jobs held in 1993-1997. The final right-hand term, $\left[\bar{X}_{01-05} - \bar{X}_{93-97}\right]\left[\hat{\beta}_{93-97} - \hat{\beta}_{01-05}\right]$ accounts for the fact the means and coefficients change simultaneously. Results of the decomposition are presented in Table 4, with the change in the variable means presented in the Appendix.

The difference between the displacement rates of 1993-1997 and 2001-2005 is 0.09 percentage points, and not significantly from zero. According to the results of the Blinder–Oaxaca decomposition, the displacement rate in 2001-2005 was reduced by 0.21 percentage points because workers had different levels of education, tenure, industry mix, and other characteristics than workers in 1993-1997. However, because the effect of these characteristics changed, according to this analysis, the displacement rate in 2001-2005 was raised by 0.20 percentage points.

Breaking down the change by variables using the Blinder–Oaxaca decomposition shows the contribution the change in the level (endowment) and effect (coefficient) of each characteristic on the incidence of displacement. For the share of employment in manufacturing, the "endowment effect" is the percentage point change in the share of workers in manufacturing (-4.5 percentage points, the decline from 18.7 percent in 1993-1997 to 14.2 percent in 2001-2005, as shown in the Appendix) multiplied by the effect of the share of employment in manufacturing on displacement in 2001-2005 (0.067, as shown in Table 2), or -0.30 (-4.5*0.067, as shown in Table 4). Similarly, the "coefficient effect" multiplies the change in the coefficient relating the share of employment in manufacturing to displacement (0.046, the rise from 0.021 in 1993-1997 to 0.067 in 2001-2005, as shown in Table 2) by the share of manufacturing in employment in 2001-2005 (14.2, as shown in the Appendix), or 0.66 (0.046*14.2, as shown in Table 4). The interaction between the change in endowment and the change in the coefficient resulted in an increase in the incidence of displacement by 0.21 percentage points (Table 4). Thus, the overall effect of the share of employment in manufacturing raised the incidence of displacement by 0.57 percentage points between 1993-97 and 2001-2005 (Table 5).

Contrary to our expectations, increased educational attainment had no significant impact on the incidence of displacement. Table 4 presents the effect of each educational category on the displacement rate, while Table 5 shows the effect of all educational categories combined. The "endowment effect" of educational attainment lowered the displacement rate by 0.03 percentage points (Table 5). Despite significant increase in educational attainment, the "endowment effect" is not very strong due to the very small effect of educational attainment on the probability of displacement in 2001-2005. Indeed, the "coefficient effect" raised the displacement rate by 0.24 percentage points and more than offset the negative "endowment effect".[13] Including the "interaction effect," the overall effect of educational attainment was

[13] Note that the differences between results presented in Tables 4 and 5 are due to rounding.

to raise the displacement rate 0.17 percentage points, although this result is not statistically significant.

It is difficult to see the extent to which the decline in tenure since the early 1980s affected displacement due to the small changes in job tenure during the period under review. While the percentage of the workers with 10 or more years of tenure declined from 28.7 to 28.3 percent, the percent of workers with less than one year of tenure declined from 9.9 to 9.0 percent (see the Appendix). The overall "endowment effect" is negative and small due to the smaller number of people with short tenure (the "endowment effect" of having less than one year of tenure (9.0-9.9)*0.023 plus effect of having 5-10 years of tenure (22.3-21.2)*-0.06 plus effect of having 10 or more years of tenure (28.3-28.7)*-0.08). The "coefficient effect" of tenure on displacement has slightly strengthened, producing a 0.22 percentage point decline in the displacement rate (Table 5), while the "interaction effect" has been negligible. The overall effect of tenure has been negative and marginally significant. However, the change in tenure during this short period of time is non-representative of the change that occurred in the 1980's and 1990's (Table 1). We believe that the decline in tenure created an upward pressure on the displacement rate over the last 20 years: an effect that is difficult to measure due to design changes of the DWS and lack of information on tenure.

Decomposition of the displacement rate by age also helps explain the convergence in the displacement rates of younger and older workers.[14] As seen in Table 5, the factors under review caused little change in the displacement rate for prime-age workers but significantly raised displacement among older workers. In both groups, the effects in manufacturing raised displacement in both groups, by 0.55 and 0.68 percentage points for prime-age and older workers respectively. However, among prime-age workers tenure effects reduced displacement while among older workers the effects of both tenure and educational attainment further increased the incidence of displacement.

[14]Means are presented in the Appendix. Coefficients by age are presented in Table 3.

The effects identified by the decomposition by age are surprising, as tenure declined and educational attainment rose among both groups (Table 1). But the ability of these factors to affect displacement changed in different ways. The ability of tenure to reduce displacement, the "coefficient effect", became stronger for prime-age workers and more than offset its decline in that age group. Thus, the overall effect of tenure lowered the displacement rate for prime-age workers by 0.30 percentage points and increased the displacement rate for older workers by 0.12 percentage points.

The effect of educational attainment for older workers is counterintuitive. As Table 3 demonstrates, conditional on manufacturing industry and public sector, older college graduates are more likely to be displaced in 2001-2005, although the coefficient is insignificant (Table 3). Thus, while being insignificant, the "endowment effect" of increased educational attainment has raised displacement rates by 0.06 percentage points rather than reduced them for older workers. While the relationship between educational attainment and displacement has weakened for prime-age workers, this relationship has worsened for older workers. Thus, the "coefficient effect" has an upward effect on the displacement for older workers. While the overall effect of educational attainment for prime-age workers has increased displacement rates by 0.02 percentage points, older workers have experienced a 0.29 percentage point increase in the incidence of displacement (Table 5).

While the overall effects of educational attainment and tenure have been insignificant for prime-age and older workers, the combination of these effects with the effect of manufacturing on displacement made a difference. While the tenure effect has diminished the upward effect of manufacturing for prime-age workers, tenure and educational attainment effects reinforced the upward effect of manufacturing on the displacement for older workers.

4 Conclusion

Using consistent data on the displaced workers and tenure information for all workers available since 1996 in the Displaced Worker Survey, this analysis shows that conditional on tenure, industry, and education, older workers have become more likely to be displaced. Declining tenure, higher risk of displacement in manufacturing, and worsened relationship between educational attainment and displacement helps explain increased incidence of displacement for older workers. While prime-age workers have experienced an increasing incidence of displacement in the manufacturing sector as well, the strengthened effect of tenure on displacement and a weakened relationship between educational attainment and displacement have offset the effect of manufacturing on displacement. A surprising result is that for older and prime-age workers having a college degree has no significant effect on displacement after controlling for manufacturing and the public sector.

An increased incidence of displacement for older workers is bad news. Given the contraction of national retirement income and rising longevity, working longer is the main approach of guaranteeing an adequate standard of living in retirement. Displacement leads to premature retirement (Stevens and Chan (2001)) and a lower standard of living in retirement (Johnson, Mermin, Uccello (2005)). Moreover, most policies encouraging longer working lives, such as raising the Social Security's Earliest Eligibility Age from 62 to 64, target labor supply. These policies will have limited success given that labor demand considerations are also responsible for a lower labor force participation rate of older workers.

The changes in manufacturing, tenure, and educational attainment during the last ten years are only a small fraction of the changes that occurred since the early 1980s. Changes in the design of the DWS prevent us from using a longer period of time to investigate the trends in displacement in more detail. However, this study suggests that a solution to the puzzle—

why dislocation rates have been relatively stable while tenure has declined—appears to be the decline in the share of employment in manufacturing. The "endowment effect" of the decline in manufacturing clearly reduces displacement, offsetting the rise in displacement resulting from declining tenure.[15] While employment in manufacturing is relatively long-tenured, the decline in tenure does not just reflect the decline of manufacturing, as tenure declined in all industries. If both the decline in tenure and the decline of the manufacturing sector reflect a common factor, such as technological change or rising educational attainment, then the effects of this common factor on displacement seem to be largely offsetting.

[15] The overall effect of manufacturing would have this effect only if its "coefficient effect" over the earlier period of time, unlike the period under review, did not reverse the "endowment effect."

References

[1] Farber, Henry S. 1993. "The Incidence and Costs of Job Loss: 198291." *Brookings Papers on Economic Activity: Microeconomics*, No.1, pp.73119.

[2] Farber, Henry S. 1997a. "The Changing Face of Job Loss in the United States, 19811995." *Brookings Papers on Economic Activity: Microeconomics*, pp.55128.

[3] Farber, Henry S. 1997b. "Trends in Long-Term Employment in the United States, 19791996." *Working Paper* 384, Industrial Relations Section, Princeton University.

[4] Farber, Henry S. 2003. "Job Loss in the United States, 19812001?" *Working Paper* 471, Industrial Relations Section, Princeton University.

[5] Farber, Henry S. 2005. "What Do We Know about Job Loss in the United States, 19842004?" *Working Paper* 498, Industrial Relations Section, Princeton University.

[6] Farber, Henry S. 2006. "Is the Company Man an Anachronism? Trends in Long Term Employment in the U.S., 1973-2006." *Working Paper* 518, Industrial Relations Section, Princeton University.

[7] Farber, Henry S. 2007. "Job Loss and the Decline in Job Security in the United States." *Working Paper* 520. Industrial Relations Section, Princeton University.

[8] Johnson, Richard W., Mermin, Gordon B.T., and Cori E. Uccello. 2005. "When the Nest Egg Cracks: Financial Consequences of Health Problems, Marital Status Changes, and Job Layoffs at Older Ages." *Working Paper* 2005-18. Chestnut Hill, MA: Center for Retirement Research at Boston College.

[9] Kletzer, Lori G. 1998. "Job Displacement." *Journal of Economic Perspectives* 12, pp.11536.

[10] Munnell, Alicia, Kelly Haverstick, and Geoffrey Sanzenbacher. 2006. "Job Tenure and Pension Coverage." *CRR Working Paper* 2006-18. Chestnut Hill, MA: Center for Retirement Research at Boston College.

[11] Jann, Ben. 2008. "A Stata Implementation of the Blinder-Oaxaca Decomposition." *ETH Zurich Sociology Working Paper* 5.

[12] Munnell, Alicia H., and Steve Sass. 2008. "Working Longer: The Solution to the Retirement Income Challenge." Washington, DC: Brookings Institution Press.

[13] Rodriguez, Daniel and Madeline Zavodny. 2000. "Are Displaced Workers Finished at Forty?" *Economic Review*. Federal Reserve Bank of Atlanta. Second Quarter: 33-47.

[14] Rodriguez, Daniel and Madeline Zavodny. 2003. “Changes in the Age and Education Profile of Displaced Workers.” *Industrial and Labor Relations Review*, Vol. 56, No. 3, pp.498-510.

[15] Stevens, Ann Huff, and Sewin Chan. 2001. “Job Loss and Employment Patterns of Older Workers.” *Journal of Labor Economics*, Vol.19, No.2, pp.484-521.

5 Appendix

Table 1: Characteristics of the Workforce by Age, CPS 1984-2006.

	1984		2006	
Characteristic:	Age 35-49	Age 50-64	Age 35-49	Age 50-64
Percent of high school drop-outs	18%	33%	14%	13%
Percent with college degree	23	15	30	30
Job tenure, median	7	13	5	10
Percent working in manufacturing	22	23	13	13

Note: There is no tenure information in 1984. Job Tenure and Mobility Supplement in 1983 has been used to calculate tenure in 1984.

Source: Authors' calculations based on the Current Population Survey (1984-2006) and Job Tenure and Mobility Supplement (1983-2006).

Table 2: Estimates of the Linear Probability Model of Job Loss, 1993-2005.

	Controlling for tenure		
Variable:	1993-1997	1997-2001	2001-2005
Age 20-34	-0.017**	-0.015**	-0.020**
	(0.002)	(0.002)	(0.002)
Age 50-64	0.003	0.009**	0.013**
	(0.003)	(0.002)	(0.002)
Female	-0.010**	-0.006**	-0.008**
	(0.002)	(0.002)	(0.002)
Nonwhite	0.001	0.005*	0.012**
	(0.003)	(0.002)	(0.002)
ED<12	0.014**	0.001	0.009**
	(0.004)	(0.003)	(0.003)
ED 13-15	0.001	0.002	0.002
	(0.002)	(0.002)	(0.002)
ED≥16	-0.018**	-0.012**	-0.009**
	(0.003)	(0.002)	(0.002)
Manufacturing	0.021**	0.043**	0.067**
	(0.003)	(0.002)	(0.003)
Public sector	-0.046**	-0.052**	-0.050**
	(0.003)	(0.002)	(0.003)
Tenure <1	0.020**	0.027**	0.023**
	(0.003)	(0.003)	(0.003)
Tenure 5-10	-0.057**	-0.061**	-0.060**
	(0.003)	(0.002)	(0.002)
Tenure ≥ 10	-0.075**	-0.076**	-0.080**
	(0.003)	(0.002)	(0.002)
Constant	0.124**	0.110**	0.110**
	(0.003)	(0.003)	(0.003)
Year FEs	yes	yes	yes
N	82,510	93,560	97,506
R-squared	0.0259	0.0317	0.0341

Note: Significance levels : † : 10% $*$: 5% $**$: 1%
The dependent variable is one if a worker reports being displaced in the three years prior to the survey (because of plant closure, position abolished, or slack work) and zero otherwise. Sample excludes self-employed individuals. The omitted age category is 35-49. The omitted educational category is high school. Observations are weighted using the CPS final weights. Note that total displacement rate for 1993-1997 was 8.5 percent, 1997-2001 was 8.1, and 2001-2005 was 8.6.

Table 3: Estimates of the Linear Probability Model of Job Loss by Age, 1993-2005.

	Age 35-49		Age 50-64	
Variable:	1993-1997	2001-2005	1993-1997	2001-2005
Female	-0.010**	-0.009**	-0.010*	0.003
	(0.003)	(0.003)	(0.004)	(0.003)
Nonwhite	-0.002	0.014**	-0.002	0.005
	(0.004)	(0.004)	(0.006)	(0.005)
ED<12	0.010†	0.003	0.003	0.006
	(0.005)	(0.005)	(0.007)	(0.007)
ED 13-15	0.008*	0.005	0.014**	0.013**
	(0.004)	(0.004)	(0.005)	(0.004)
ED≥16	-0.006†	0.000	-0.001	0.007
	(0.004)	(0.003)	(0.005)	(0.004)
Manufacturing	0.024**	0.065**	0.032**	0.085**
	(0.004)	(0.004)	(0.005)	(0.005)
Public sector	-0.044**	-0.052**	-0.039**	-0.048**
	(0.004)	(0.004)	(0.005)	(0.004)
Tenure<1	0.021**	0.020**	0.016	0.026**
	(0.006)	(0.006)	(0.010)	(0.009)
Tenure 5-10	-0.059**	-0.066**	-0.068**	-0.066**
	(0.004)	(0.004)	(0.006)	(0.005)
Tenure≥10	-0.078**	-0.082**	-0.086**	-0.087**
	(0.003)	(0.003)	(0.005)	(0.004)
Constant	0.141**	0.140**	0.132**	0.115**
	(0.004)	(0.004)	(0.006)	(0.005)
Year FEs	Yes	Yes	Yes	Yes
N	35,791	40,221	16,668	26,157
R-squared	0.0294	0.0384	0.0311	0.0442

Note: Significance levels : † : 10% * : 5% ** : 1%
The dependent variable is one if a worker reports being displaced in the three years prior to the survey (because of plant closure, position abolished, or slack work) and zero otherwise. Sample excludes self-employed individuals. The omitted age category is 35-49. The omitted educational category is high school. Observations are weighted using the CPS final weights. Note that total displacement rate for 1993-1997 was 8.5 percent, 1997-2001 was 8.1, and 2001-2005 was 8.6.

Table 4: Blinder–Oaxaca Decomposition of Percentage Point Change in the Displacement Probabilities, 1993-1997 vs. 2001-2005.

	All			Age 35-49			Age 50-64		
Effect	Endowm.	Coeff.	Interac.	Endowm.	Coeff.	Interac.	Endowm.	Coeff.	Interac.
Age 20-34	0.07^{**}	-0.11	-0.01	-	-	-	-	-	-
	(0.01)	(0.10)	(0.01)	-	-	-	-	-	-
Age 50-64	0.07^{**}	0.23^{**}	-0.05^{**}	-	-	-	-	-	-
	(0.01)	(0.09)	(0.02)	-	-	-	-	-	-
ED<12	-0.01^{*}	-0.05	-0.004	0.00	-0.06	0.00	-0.03	0.02	0.01
	(0.003)	(0.04)	(0.003)	(0.001)	(0.06)	(0.002)	(0.03)	(0.07)	(0.04)
ED 13-15	0.00	0.01	0.00	-0.006	-0.09	-0.004	0.05^{**}	-0.04	0.01
	(0.00)	(0.10)	(0.001)	(0.005)	(0.14)	(0.01)	(0.02)	(0.19)	(0.03)
ED≥16	-0.03^{**}	0.28^{**}	-0.03^{*}	0.00	0.19	-0.01	0.04	0.28	-0.05
	(0.01)	(0.11)	(0.01)	(0.01)	(0.17)	(0.01)	(0.03)	(0.23)	(0.04)
Manufacturing	-0.30^{**}	0.66^{**}	0.21^{**}	-0.24^{**}	0.64^{**}	0.15^{**}	-0.39^{**}	0.83^{**}	0.25^{**}
	(0.02)	(0.05)	(0.02)	(0.02)	(0.08)	(0.02)	(0.04)	(0.11)	(0.04)
Tenure <1	-0.02^{**}	0.02	0.002	-0.01^{*}	-0.02	-0.002	-0.01	0.04	0.002
	(0.004)	(0.04)	(0.005)	(0.005)	(0.05)	(0.005)	(0.01)	(0.06)	(0.004)
Tenure 5-10	-0.07^{**}	-0.09	0.004	-0.12^{**}	-0.21	0.015	-0.09^{**}	0.03	-0.002
	(0.01)	(0.08)	(0.004)	(0.02)	(0.13)	(0.01)	(0.03)	(0.16)	(0.01)
Tenure $\geq$ 10	$0.03^{\dagger}$	-0.14	-0.002	0.22^{**}	-0.16	-0.01	0.22^{**}	-0.06	-0.003
	(0.017)	(0.10)	(0.002)	(0.03)	(0.16)	(0.01)	(0.04)	(0.34)	(0.02)
Total	-0.21^{**}	0.20	0.10^{**}	-0.03	0.10	0.10^{**}	-0.21^{**}	0.75^{**}	0.19^{**}
	(0.03)	(0.13)	(0.03)	(0.04)	(0.20)	(0.03)	(0.07)	(0.26)	(0.07)
Displ. rate 2001-2005		8.55			8.27			8.03	
Displ. rate 1993-1997		8.46			8.10			7.30	
Difference		0.09			0.17			0.73^{**}	
		(0.13)			(0.19)			(0.26)	

Note: Significance levels : † : 10% $*$: 5% $**$: 1%

Note that only key variables have been presented in this table. A worker considered to be displaced if he/she reports losing a job in the three years prior to the survey because of plant closure, position abolished, or slack work. Sample excludes self-employed individuals. The omitted age category is 35-49. The omitted educational category is high school. Observations are weighted using the Current Population Survey final weights.

Table 5: Net Effect of Changes in Characteristics and Relationships on Displacement, 1996-1998 vs. 2004-2006.

Characteristic:	Endowment	Coefficient	Interaction	Total
All				
Age	0.14**	0.12	-0.07**	0.20
	(0.01)	(0.16)	(0.02)	(0.16)
Education	-0.04**	0.24	-0.03**	0.17
	(0.01)	(0.20)	(0.01)	(0.20)
Manufacturing	-0.30**	0.66**	0.21**	0.57**
	(0.02)	(0.05)	(0.02)	(0.06)
Tenure	-0.06**	-0.22	0.00	-0.27
	(0.02)	(0.17)	(0.01)	(0.17)
Age 35-49				
Education	-0.01	0.04	-0.02†	0.02
	(0.01)	(0.30)	(0.01)	(0.30)
Manufacturing	-0.24**	0.64**	0.15**	0.55**
	(0.02)	(0.08)	(0.02)	(0.09)
Tenure	0.08**	-0.39	0.00	-0.30
	(0.03)	(0.28)	(0.01)	(0.28)
Age 50-64				
Education	0.06	0.26	-0.03	0.29
	(0.04)	(0.40)	(0.06)	(0.40)
Manufacturing	-0.39**	0.83**	0.25**	0.68**
	(0.04)	(0.11)	(0.04)	(0.12)
Tenure	0.12**	0.00	0.00	0.12
	(0.04)	(0.47)	(0.02)	(0.47)

Note: Significance levels : † : 10% * : 5% ** : 1%
Results are based on Tables 2, 3, 4, and the Appendix Table.

Table 6: Distribution of Tenure by Age, CPS 2006.

Age category:	Tenure<1	Tenure 1-5	Tenure 5-10	Tenure≥10	Total
Age 20-34	17%	59%	20%	5%	101%
Age 35-49	8	34	25	33	100
Age 50-64	5	25	20	50	100

Source: Authors calculations based on the Current Population Survey 2006 and Job Tenure and Mobility Supplement 2006.

Table 7: Estimates of the Linear Probability Model of Job Loss without Controls for Tenure, 1993-2005 .

	Without controlling for tenure		
Variable:	1993-1997	1997-2001	2001-2005
Age 20-34	0.008**	0.012**	0.008**
	(0.002)	(0.002)	(0.002)
Age 50-64	-0.007**	-0.002	0.002
	(0.003)	(0.002)	(0.002)
Female	-0.006**	-0.001	-0.005*
	(0.002)	(0.002)	(0.002)
Nonwhite	0.003	0.008**	0.015**
	(0.003)	(0.002)	(0.002)
ED<12	0.021**	0.009**	0.016**
	(0.004)	(0.003)	(0.003)
ED 13-15	0.002	0.003	0.002
	(0.002)	(0.002)	(0.002)
ED≥16	-0.017**	-0.011**	-0.010**
	(0.003)	(0.002)	(0.002)
Manufacturing	0.012**	0.034**	0.057**
	(0.003)	(0.002)	(0.003)
Public sector	-0.058**	-0.064**	-0.061**
	(0.003)	(0.002)	(0.003)
Tenure <1	-	-	-
	-	-	-
Tenure 5-10	-	-	-
	-	-	-
Tenure ≥ 10	-	-	-
	-	-	-
Constant	0.085**	0.070**	0.070**
	(0.003)	(0.002)	(0.002)
Year FEs	yes	yes	yes
N	82,510	93,560	97,506
R-squared	0.0119	0.0155	0.0188

Note: Significance levels : † : 10% $*$: 5% $**$: 1%
The dependent variable is one if a worker reports being displaced in the three years prior to the survey (because of plant closure, position abolished, or slack work) and zero otherwise. Sample excludes self-employed individuals. The omitted age category is 35-49. The omitted educational category is high school. Observations are weighted using the CPS final weights. Note that total displacement rate for 1993-1997 was 8.5 percent, 1997-2001 was 8.1, and 2001-2005 was 8.6.

Table 8: Characteristics of the Workforce by Age and Year of the Survey, CPS 1996-2006.

	All		Age 35-49		Age 50-64	
Variable:	1996-1998	2004-2006	1996-1998	2004-2006	1996-1998	2004-2006
Displacement rate	0.085	0.086	0.081	0.083	0.073	0.080
Age 20-34	0.380	0.345	-	-	-	-
Age 50-64	0.192	0.251	-	-	-	-
Female	0.471	0.472	0.475	0.473	0.476	0.488
Non-white	0.151	0.158	0.149	0.163	0.127	0.133
ED<12	0.097	0.090	0.086	0.085	0.129	0.081
ED 13-15	0.299	0.296	0.292	0.279	0.241	0.278
ED≥16	0.286	0.317	0.306	0.331	0.289	0.350
Manufacturing	0.187	0.142	0.193	0.156	0.200	0.154
Public sector	0.166	0.159	0.189	0.166	0.213	0.216
Tenure<1	0.099	0.090	0.070	0.063	0.045	0.043
Tenure 5-10	0.212	0.223	0.237	0.256	0.190	0.204
Tenure≥10	0.287	0.283	0.367	0.341	0.538	0.513

Note: A worker considered to be displaced if he/she reports losing a job in the three years prior to the survey because of plant closure, position abolished, or slack work. Sample excludes self-employed individuals. Observations are weighted using the Current Population Survey final weights.
Note that characteristics from Table 1 may not correspond to characteristics in Table 8 since Table 1 is based on the March Supplement and Table 8 is based on the January Supplement to the CPS. January Supplement is representative of workforce rather than overall population. While Table 1 is constructed to demonstrate trends in population, Table 8 facilitates a Blinder–Oaxaca decomposition.