Early Claiming of Social Security Benefits and Labor Supply Behavior of Older Americans[†]

Hugo Benítez-Silva[‡]
SUNY-Stony Brook

Frank Heiland
Florida State University

December 5, 2005

Abstract

The labor supply incentives provided by the early retirement rules of the United States Social Security Old Age benefits program are of growing importance as the Normal Retirement Age (NRA) increases to 67, and the labor force participation of Older Americans starts to increase. These incentives allow individuals who claim benefits before the NRA but continue to work, or return to the labor force, to increase their future rate of benefit pay by having benefits withheld. Since the adjustment of the benefit rate takes place only after the NRA is reached, benefits received before the NRA can become actuarially unfair for those who continue to work after claiming. Consistent with these incentives, estimates, using a bivariate hazard model of the monthly exit and claiming hazard using data from the Health and Retirement Study indicate that early claimers who continue to work are likely to exit the labor force later than non-claimers. Moreover, early claimers who re-enter the labor force are likely to have longer employment spells than non-claimers who return to the labor force.

Keywords: Retirement Benefits, Actuarial Reduction Factor, Earnings Test, Duration Analysis, Health and Retirement Study
JEL classification: J26, H55, C41

[†] We are grateful to a number of employees of the Social Security Administration who have patiently answered our questions. These employees include attendants in the Toll-Free number of the SSA, a number of claim representatives in the Field Office in Patchogue (Suffolk County, New York), and also a number of researchers of the SSA who have clarified many issues. Among the latter, Barbara Lingg, Christine Vance, and Joyce Manchester have been especially generous with their time. We are thankful to Stan Panis for his help using the aML software. We are also thankful, for their comments and suggestions, to the participants of the Conference on Improving Social Insurance Programs at the University of Maryland, the participants of the Applied Micro Seminar at the University of Maryland, the participants at SOLE 2004, and the participants of the Conference on Labor Market Policy Evaluation in Seville. We also thank Gary Fournier, Dave Macpherson, Huan Ni, John Rust, and Caroline Austin for their useful comments and suggestions. Benítez-Silva is grateful for the financial support from the Spanish Ministry of Science and Technology through project number BEC2002-04294-C02-01 and to the Fundación BBVA. Any remaining errors are our own.

[‡] **Benítez-Silva:** Economics Department, State University of New York at Stony Brook, Stony Brook, N.Y. 11794-4384, phone: (631) 632-7551, fax: (631) 632-7516, e-mail: hugo.benitez-silva@sunysb.edu

1 Introduction

As of October of 2005, 70.2% of men and 75.3% of women in the U.S. claimed Social Security benefits before the Normal Retirement Age (NRA) compared to 36% and 59% in 1970, respectively.[1] The U.S. Social Security system provides fairly complex incentives that can affect the labor supply behavior of workers between the early and NRA. Some of the most important incentives are the Earnings Test, which determines the maximum level of earnings that do not result in a benefit reduction for individuals who have claimed retirement benefits before the NRA, and the Actuarial Reduction Factor (ARF), which determines the permanent reduction in benefits that individuals face if they claim benefits early. However, these incentives are also some of the most widely misunderstood features of Social Security. This is due in part to the relatively little research on labor supply and claiming behavior of early retirees, and the absence of any formal analysis of the possibility of affecting the Actuarial Reduction Factor by working after claiming benefits. This research is an attempt to fill this gap by jointly modeling labor supply and claiming decisions in a duration analysis framework, at a time when these incentives, which affect all Americans reaching retirement age, will be in place for a longer and longer period as the NRA increases to 67 in the next few years, and maybe further as a way of reforming the Social Security system to assure its future sustainability.

Individuals who claim benefits before the NRA but continue to work or re-enter the labor force after a leisure spell can reduce the early retirement penalty by suspending benefit payments.[2]

[1] The early retirement age is 62. The NRA will increase from the current 65 and six months to 67 for cohorts born in 1941 to 1960 and thereafter. The shift towards early claiming of benefits has happened in many countries as described for example in Gruber and Wise (2004)

[2] In this paper we are not considering spousal benefits and joint decision making in the household. The complexities introduced by those considerations are out of the scope of this analysis. See Votruba (2003) for a discussion. By ignoring spousal benefits we are not taking into account the fact that approximately 5.96% of the individuals who receive some type of Old Age, Survivors, or Disability Insurance (OASDI) benefits receive them as spouses of an entitled retiree. This percentage comes from the Public-Use Microdata File provided by the SSA and refers to a 1% random sample of all beneficiaries as of December of 2001.

The early retirement reduction factor, in turn, will be increased proportionally to the number of months without benefits, which will increase benefits permanently after the individual reaches the NRA. Any benefits received before the NRA are subject to the (unadjusted) reduction factor that corresponds to the respondent's age when benefits were initially claimed. The adjustment mechanism of the Actuarial Reduction Factor allows those who become beneficiaries before the NRA to partially or completely reverse the financial consequences of their decision, averting being locked-in at the reduced rate.[3]

To illustrate these incentives we present the following example: Think of two otherwise identical individuals who turn 62 on July 1^{st} of a given year, and earn $30,000 of labor income between July of that year and the following June. They had the same earnings history and hence the same implied Primary Insurance Amount (PIA) of $11,550.[4] One of them claims benefits in the month she turns 62 while the other waits until her 63^{rd} birthday to claim benefits. Suppose first that both decide to withdraw from the labor force at the time when they claim benefits. In this case, the early claimer receives yearly benefits of $9,240 between age 62 and her death while the later claimer receives benefits of $10,010 between age 63 and her death. Clearly, in this scenario the person who claims later receives a higher benefit stream at any reasonable discount rate, assuming average longevity. Alternatively, if the early claimer decides to continue to work, earns above the earnings limit, and withdraws from the labor force at her 63^{rd} birthday, then she receives no benefits between 62 and 63, annual benefits of $9,240 between age 63 and 65, and $10,010 thereafter. In this case the benefits received after 65 are the same for the early and the later claimer since the

[3] Myers (1993, p. 52), Gruber and Orszag (1999 and 2000), and Benítez-Silva and Heiland (2005) discuss this mechanism in some detail.

[4] The PIA is calculated as a concave piece-wise linear function of the worker's average earnings subject to Social Security taxes taken over her highest 35 years of earnings. The assumed PIA is the product of a given history of earnings. With this PIA someone who claims at age 62 would be entitled to a benefit amount of $9,240 a year, assuming a NRA of 65. If that person has a labor income of $30,000 in the year after turning 62, all her benefits would be withheld. This calculation uses an Earnings Test Limit of $11,520 a year and assumes that the $30,000 labor income does not affect the PIA.

benefit rate of early claimers after the NRA is adjusted to reflect the actual benefit pick-up before the NRA.

This example illustrates two important aspects of the incentives provided by OASDI. Firstly, once benefits are claimed (here 62^{nd} vs. 63^{rd} birthday), the person who claims earlier faces a stronger incentive to participate in the labor force and earn above the earnings limit than the later claimer. This is true since earning above the Earnings Test is the only way for the earlier claimer to possibly reduce the retirement penalty associated with having claimed before the NRA. As shown by the example, the person who claimed at 62 can reduce the early retirement penalty by continuing to work and earn above the earnings limit, but cannot avoid that benefits received at any time before the NRA reflect the retirement reduction factor as of the time of claim initiation, since the adjustment of that rate does not apply until the NRA is reached. The latter point has not been made in previous research but is key to understanding that the early retirement penalty is only actuarially fair for individuals who either claim and receive benefits continuously thereafter (no adjustment of the reduction factor) or claim and have all benefit withheld due to the Earnings Test (full adjustment of the reduction factor), i.e. work continuously after claiming until the NRA. The rate of benefit pay of a person who claimed benefits before the NRA, and who has some benefits withheld, is not adjusted upwards until the NRA and hence becomes increasingly actuarially unfair as the number of month between benefit initiation and receipt increases. Secondly, if we observe individuals claiming early and continuing to work and earning above the earnings limit, it has to be that claiming early has an intrinsic value to them. We elaborate on these points in Section 3.4., when discussing our identification strategy.

There are numerous reasons for claiming benefits before the NRA while continuing to work or expecting a return to work, because having claimed benefits provides a type of insurance. First, individuals who face uncertain job prospects or uncertain income streams in general may file for

Social Security benefits as soon as they are eligible to secure benefit payments if needed. Processing the initial Social Security claim takes up to three months. Reinstating the monthly payments takes around six weeks. Also, in most states unemployment benefits are not deducted from Social Security benefits and vice-versa, i.e. unemployment benefits and Social Security benefits can be received at the same time.[5] Second, with the ongoing debate about reforming the Social Security system, individuals eligible for early retirement benefits may become claimers even though they do not plan to withdraw from the labor force. Their motivation is to insure that they cannot be made worse off by changes to Social Security. Finally, beneficiaries may find themselves in a situation where they would like to trade off their reduced benefits for increases in their future rate of benefit pay (e.g. as new job opportunities come along).

In order for the Social Security Administration to suspend benefits an individual has to earn enough above the Earnings Test Limit such that the implied taxes completely offset at least one month of benefits.[6] Consequently an increase in the Earnings Test Limit makes it more difficult for these individuals to affect their future benefit rate. Even if the benefit reduction were actuarially fair for individuals with low earnings potential, they may be made worse off by a higher Earnings Test Limit since it eliminates the option to affect the rate of future benefit pay for them. In this sense increases in the Earnings Test Limit can be regressive. This effect may be offset, however, if individuals with lower incomes also expect to have a shorter life, and therefore benefit from a higher Earnings Test Limit. In this case the Earnings Test itself can be seen as regressive since lower income individuals who see their benefits withheld may be taxed more than high income earners from a lifetime perspective (e.g., Gruber and Orszag 1999).

[5] Hutchens (1999), accounting for demand side effects, shows that early retirement benefits can be a form of unemployment insurance that can lead to inefficiently high levels of early retirement.

[6] During the first year after claiming benefits the Social Security Administration performs a monthly test to determine whether the person should receive the monthly benefit check. After the first year the test is yearly and it depends on the expected earnings of the individual.

To what extent older Americans know about some of these relatively subtle incentives has been debated. Most previous studies have argued that individuals respond to the taxation incentives provided by the Earnings Test but do not take the adjustment of the rate of future benefits into account.[7] Some anecdotal evidence we have gathered indicates that future retirees can have a hard time finding the appropriate information to make truly informed decisions regarding the effects of work after claiming benefits.[8] However, these incentives have been in place in this form for more than two decades and the specifics of benefit withholding due to the Earnings Test and subsequent adjustment of the reduction factor are documented in the Social Security Handbook (SSA-H) and the internal operating manual used by Social Security field employees when processing benefit claims (SSA-M). In addition, several employees from the Social Security Administration, including claim representatives at a local SSA, office confirm that these rules are implemented by the government when calculating retirement benefits.

While the details of the effect of the reduction factor on labor supply behavior and earnings have been documented, their role in initiating the receipts of benefits early, continuing employment after reaching the early retirement age, and the level of earnings has not been formally investigated. Most existing early retirement research has focused on individuals who claim benefits and withdraw from the labor force at the same time. However, benefit receipt data from SSA indicate that

[7] Reimers and Honig (1993 and 1996) interpret their findings that current Social Security benefits not Social Security wealth predict labor force reentry behavior as evidence that individuals do not take the subsequent replacement of withheld benefits into account. However, their analysis does not consider the possibility that individuals seek to affect the reduction factor by continuing to work. Friedberg (1998 and 2000) studies the effect of changes in the Earnings Test rule prior to 2000 on labor supply and finds that up to 5 percent of individuals bunch just below the Earnings Test limit and appear to adjust with the Earnings Test Limit, suggesting that these individuals may perceive benefits that are withheld as lost. Benítez-Silva and Heiland (2005) estimate that no more than 30% of older Americans may know about these incentives.

[8] For example, the benefits calculator provided by the Social Security Administration (`www.ssa.gov`) does not have any reference to the mechanism that allows individuals to affect their Actuarial Reduction Factor by earning above the Earnings Test after claiming and receiving benefits. In recent months SSA has been updating a number of its publications regarding the role of work after claiming benefits. In the package of information that individuals receive once they claim benefits it is now included a considerably clearer statement about the consequence of working while claiming benefits. These statements do not only focus on the taxation aspects, but describe in simple terms the adjustment mechanism. These are SSA Publication No. 05-10077, and SSA Publication No. 05-10069.

an estimated 8.5% of all individuals who claim benefits before the NRA in 2001 had some benefits withheld because of their earnings (SSA 2002, p. 256).[9] This suggests that there is a sizable group of individuals who have claimed benefits and either worked continuously or re-entered the labor market.

Descriptive evidence from the Health and Retirement Study (HRS) also supports the importance of the group of individuals who claim benefits before they withdraw from the labor market. Figure 1 plots the month-claiming and labor force exit behavior of the individuals in our sample. Points along the diagonal represent individuals who claimed and exited the labor force around the same time whereas points to the right of the diagonal represent those who exited the labor force later than the month they claimed benefits.[10] This latter group which contains more than 200 individuals is the one we are most interested in. Although the behavior associated with this group, continuation of work after claiming, is not as common as claiming and exiting at the same time or claiming after exiting (1,730 cases), this group is still substantial, and a majority of these individuals claimed within three months of turning 62, but continued working up to 30 months after. This is evidence of the potential importance of the mechanisms we describe and analyze in this paper.

Our hypothesis is that the possibility to reverse part or all of the (lifetime) penalty associated with claiming benefits early, and the fact that the reduced rate associated with early retirement is not adjusted before the NRA for those who claim early and have some benefits withheld, has important consequences for early retirement behavior and labor supply between age 62 and the

[9] The SSA provides estimates based on a 1% random sample of all beneficiaries as of December of 2001 from the Master Beneficiary Record. An estimated 100,000 of all individuals who claimed benefits early in 2001 saw their benefits withheld, and therefore had their actuarial reduction factor affected by their labor supply decisions after claiming benefits.

[10] Notice that this is not a density plot, therefore each dot can represent multiple individuals. However, the density plots (not shown) did not add much information to what Figure 1 already shows. Points in the boundaries ('-1', '0', '39', '40') represent censored observations, which account for individuals that are either right censored ('40') or do not claim by age 65 ('39'), do not exit the labor force by age 65 ('39'), or were not working on their 62^{nd} birthday and not working ('0') or with missing work data ('-1') the month before turning 62, depending on the quadrant in the figure.

NRA. While the majority of early claimers withdraw from the labor force at the time of claiming, or before, to enter retirement, a group of early claimers who continue to work exists. This group should—*ceteris paribus*—have a longer employment spell before exiting the labor force than their counterparts who claim benefits later. The reason is that those who claim earlier face a low benefit rate if they withdraw from the labor force at that time. Early claimers have a greater incentive than later claimers to continue to work and earn above the earnings limit to increase the benefit rate effective when they retire after reaching their NRA. Moreover, by the same logic, early claimers who initially withdrew from the labor force but decide to return should also have longer employment spells than later claimers in the same situation.

We present estimates of exit and claiming continuous time proportional hazard models both in a single equation setting and a simultaneous equations framework, using data from the HRS to investigate the role of the time of initiation of Social Security benefits in labor force participation behavior of Americans between ages 62 and 65. While our results confirm that early claimers are more likely to exit the labor market than those who have not claimed yet, we also find an exit pattern among claimers who is consistent with the trade-offs provided by the early retirement incentives. The model predicts that an individual who claimed early benefits in a particular month is about 21.1% less likely to exit the labor market in the following month than an individual who had not claimed benefits at that time.

The remainder of the paper is structured as follows. Section 2 provides a short literature overview, Section 3 describes the incentives provided by the ARF and the Earnings Test for individuals' labor supply decisions and earnings, and the empirical strategy to identify the role of the option to adjust the ARF on exit from and re-entry to the labor force. Section 4 describes the data, and the econometric models we estimate. Section 5 presents the empirical results, including results from exit and re-entry hazard models, and a simultaneous model of labor force exit and claiming

behavior. Section 6 offers some concluding remarks.

2 Overview of the Literature

The general retirement literature is vast.[11] Its main objective has been to try to understand the effect of Social Security on labor supply and wealth accumulation, but it has paid relatively little attention to the implications of work after claiming benefits between the early and normal retirement age. In particular the implications of affecting future benefits by working more and earning above the earnings limits, for retirement behavior before the normal retirement age have not been carefully investigated yet. These incentives are becoming an increasingly more important aspect of the social insurance system in the United States as the period between the early and normal retirement age widens. This study provides one of the first empirical investigations of the behavioral implications of these incentives.

Within the literature on early retirement and labor supply one line of research has focused on the taxation aspects of the Earnings Test (Vroman 1985, Burtless and Moffitt 1985, Honig and Reimers 1989, Leonesio 1990, Reimers and Honig 1993, Reimers and Honig 1996, Friedberg 1998, Baker and Benjamin 1999, Friedberg 2000, and Votruba 2003), but has paid little attention to the potential impact that having the option to affect the reduction factor even after claiming benefits early (i.e. before NRA) may have on retirement behavior. Other related literature has approached the issue by estimating structural models of retirement (Rust and Phelan 1997; French 2005; Gustman and Steinmeier 2002; van der Klaauw and Wolpin 2005, to name some of the most recent research efforts), but in that work there is little discussion of the mechanism we are emphasizing, and it is unclear to what extent the findings from that literature reflect this particular

[11] For a recent survey of this broad retirement literature see Lumsdaine and Mitchell (1999). Hurd (1990), Lumsdaine (1995), and Ruhm (1996) provide good discussions of the earlier literature.

set of incentives provided by Social Security.

Reimers and Honig (1993 and 1996) do analyze the trade-offs of claiming early versus late in the context of re-entry into the labor market. However, the possibility that individuals can affect the reduction factor by continuing to work is ignored. Friedberg (1998 and 2000) studies the effect of changes in the Earnings Test rule prior to 2000 on labor supply and finds that up to 5 percent of individuals bunch just below the Earnings Test limit and appear to adjust with the Earnings Test Limit. This suggests that there are individuals who consider benefits withheld due to the Earnings Test as a loss, either due to misinformation or differences that make the adjustment actuarially unfair for them (e.g., lower life expectancy). However, this does not rule out that a second group of individuals exists that is aware that benefits withheld before the NRA increase the rate of future benefit pay and that take this option of adjusting the reduction factor into account.

The study of the claiming of retirement benefits has received considerably less attention than retirement itself. Rust and Phelan (1997) explicitly model retirement and application for Social Security benefits, and find that their dynamic programming model performs quite well in matching the data from the Retirement History Survey regarding employment and claiming of benefits. However, they do not directly model the possibility of affecting future benefits by working after claiming benefits. Instead, they include in their structural estimations a series of dummies for individuals who claim benefits and continue to work (p. 813–815). Their estimates of these dummies are positive, and they interpret them as leisure 'bonuses' that represent lower disutility of work after claiming benefits. In the absence of the complete incentive scheme, we believe these parameters were probably capturing the incentives we emphasize in this paper. It is our contention that future structural models will likely choose to include the incentives we describe and test as a better alternative to explaining work among Social Security claimers.[12]

[12] Although Rust and Phelan (1997) emphasize that their results are robust to including these dummies, we believe

Finally, Coile et al. (2002) analyze the Social Security benefit claiming behavior and emphasize the importance of taking into account that individuals are utility maximizers who are likely to be averse to risk. However, their focus is not on the connection between claiming and labor supply, but on understanding why some individuals delay claiming beyond age 62. They do, however, acknowledge the importance of modeling the claiming decision jointly with the retirement decision.

3 Analytical Framework and Identification Strategy

Public pensions are a major source of income to older Americans. Under the Old Age and Survivor Insurance (OASI) system, the Social Security program that pays benefits to eligible workers who claim their benefits, 40 million individuals received about $399.8 billion in benefits in 2004, and during that same year around 157 million individuals had earnings covered by Social Security and paid payroll taxes.

3.1 Benefit Calculation

Individuals aged 62 or older who had earned income that was subject to the Social Security payroll tax for at least 10 years since 1951 are eligible for retirement benefits under the Old Age benefits program. Earnings are subject to the tax up to an income maximum that is updated annually according to increases in the average wage. Around 6% of the 157 million workers with Social Security taxable earnings in 2004 had earnings at or above the maximum amount. To determine the monthly benefit amount (MBA), the Social Security Administration calculates the Primary Insurance Amount (PIA) of a worker. The PIA is calculated as a concave piece-wise linear function

the fit of their model would improve if work after claiming is allowed to influence future benefits.

of the worker's average earnings subject to Social Security taxes taken over her 35 years of highest earnings. The PIA of all individuals eligible for OA benefits is computed and updated (increased) annually in January to reflect changes in the individual's earnings history (see SSA-H, §706. *Determining the PIA*, §721. *Recomputation of the PIA*).[13]

If the benefits are claimed at the NRA (65 and 6 months for those born in 1940) the MBA equals the PIA. If an individual decides to begin receiving benefits before the NRA and exits the labor force or stays below the earnings limit, her MBA is currently reduced by up to 22.5 percent. This reduction due to claiming benefits before the NRA is approximately actuarially fair, i.e. for a person with average life expectancy the total amount of Social Security benefits received is the same regardless of the initiation date. Under the current regulation of the OA program, the monthly benefit amount received upon first claiming benefits depends on the age (month) of initiation of Social Security benefits, in the following way,

(1)

$$MBA_t = \begin{cases} (0.775 + 0.025 * \frac{1}{6} * (\text{Months not claimed in the period prior to 3 years before NRA})) * PIA \\ \qquad \text{if claimed more than 3 years before NRA;} \\ (0.80 + 0.20 * \frac{1}{36} * (\text{Months not claimed in 3 years before NRA})) * PIA \\ \qquad \text{if claimed within the 3 years before NRA.} \end{cases}$$

where MBA_t represents the monthly benefit amount before the NRA (see SSA-S 2003, p.17). Assuming that the individual continues to receive benefits, her MBA_t is permanently reduced. The Actuarial Reduction Factor (ARF) underlying this calculation is a permanent reduction of benefits by 5/9 of 1 percent per month for each month in which benefits are received in the three years

[13] This recomputation is done regardless of the level of earnings that the individual obtains after claiming benefits. Therefore individuals will benefit as long as they can substitute a low year of earnings, which could mean in some cases to substitute a year without covered earnings. Notice that this recomputation is done implicitly for non-claimers, therefore the incentive to work to affect the PIA directly through higher earnings affects claimers and non-claimers in the same way.

immediately prior to the NRA. The reduction of benefits is 5/12 of 1 percent for every month before that. Thus, the maximum actuarial reduction will reach 30% as the NRA increases to 67 over the next few years (see SSA-S 2003, p.17).[14]

3.2 Actuarial Reduction Factor

One important feature of the process of benefit reduction due to early retirement is the possibility to reduce the penalty even after initiating the receipt of benefits. The specifics of this adjustment to the Actuarial Reduction Factor are documented in the Social Security Handbook (SSA-H, §724. *Basic reduction formulas*, §728. *Adjustment of reduction factor at FRA*) and in the internal operating manual used by Social Security field employees when processing claims for Social Security benefits (SSA-M, RS00615. *Computation of Monthly Benefits Amounts*) but may not be well-understood by the retirees.[15] To illustrate the ARF, suppose the NRA is 65 years and six months, and an individual claims benefits at age 62 and n months, where $n << 42$, receives checks for x months where $(n+x << 42)$, and suspends receiving checks after that until she turns 65 and six months (after which she retires for good). In this case she receives x checks of

(2)

$$MBA_t = \begin{cases} (0.775 + 0.025 * \frac{1}{6} * n) * PIA & \text{if claimed more than 3 years before NRA;} \\ (0.80 + 0.20 * \frac{1}{36} * n) * PIA & \text{if claimed within the 3 years before NRA.} \end{cases}$$

[14] During the post NRA period additional adjustments exist: Workers claiming benefits after the NRA earn the Delayed Retirement Credit. For those born in 1943 or later it is 2/3 of 1% for each month up to age 70 which is considered actuarially fair. For those born before 1943 it ranges from 11/24 to 5/8 of 1% per month, depending on their birth year.

[15] The Social Security Administration does not use the term Actuarial Reduction Factor in their publications, but a number of the people we have talked to within the administration do use this terminology. In publications the related concept of "Reduction Factor(s)" (RF) which is simply the number of months in which benefits were received before the NRA is used. The RF maps into a "Fraction" that ranges between 0.7 and 1. The latter corresponds to what we refer to as ARF. The ARF ("Fraction") is adjusted upwards at the NRA according to the number of months before the NRA in which benefits were withheld.

After turning 65 and 6 months, her *MBA* will be permanently increased to

$$MBA_t = [0.775 + (0.20 * \frac{1}{36} * n) + (0.20 * \frac{1}{36} * (36 - n - x)) + 0.025] * PIA. \quad (3)$$

It is important to note that the adjustment of the ARF is automatic and becomes effective only after reaching the NRA.[16] Thus, given the current law, someone who has claimed benefits early and considers whether to continue to work, or considers to return to work after a leisure spell, has two incentives to stay in the labor force and to suspend the receipt of (some) Social Security benefits before the NRA. Firstly, the months before the NRA when no benefits are received increase the *MBA* after the NRA. Secondly, any benefits received before reaching the NRA remain at the same (reduced) rate that corresponds to the time of early benefit initiation. As a result the *MBA* for individuals who do not receive benefits for some months after claiming (e.g. due to the Social Security Earnings Test withholding as discussed below) becomes increasingly actuarially unfair as the number of months no benefits have been received since claiming rises.

3.3 Earnings Test

The earnings limit defines the maximum amount of income from work that a beneficiary who claims benefits before the NRA under OASI may earn while still receiving the 'full' *MBA*. Earnings above the limit are taxed at a rate of 50 percent for beneficiaries between age 62 and the January of the year in which they reach the NRA, and 33 percent from January of that year until the month they reach the NRA (SSA-S 2003, p.18; SSA-S 2004, Table 2.A18). For the latter period, the earnings limit is higher, $31,080, compared with $11,640 for the earlier period as of 2004 (SSA-S 2004, Table 2.A29). Starting in 2000 the Earnings Test was eliminated for individuals over

[16] Beneficiaries can withdraw their application for benefits. If it is retroactive, any Social Security benefits received must be returned. As a result, those who are aware of this option and who time their applications well may be able to adjust their reduction factor before the NRA, at the expense of temporarily losing the insurance function that claiming early may serve as discussed below.

the NRA. In the context of the reversibility of an early retirement penalty we want to stress that an increase in the Earnings Test Limit would make it more difficult for individuals to undo this penalty. This is due to the fact that the higher the Earnings Test Limit, the higher the earnings of an individual have to be in order to affect her ARF once she has claimed benefits.

Individuals who continue or re-enter employment after initiating Social Security benefits before the NRA, and whose earning power or hours constraints are such that their income from work is around or below the earnings limit, are mailed their monthly check from Social Security and are locked-in at the reduced benefit rate permanently. Those with earnings above the limit will not receive checks for some months and thereby increase their ARF.[17] During the first year after claiming benefits, SSA performs a monthly test to determine whether the person should receive the monthly check. As a result, an early claimer who is not working or earns below the limit in the months after claiming will receive all monthly benefits even if earnings for that calendar year ("grace year") exceed the Earnings Test Limit due to high earnings before claiming.[18] After the first year, the test is typically yearly and it depends on the expected earnings of the individual. Individuals can inform Social Security to suspend the monthly benefit payment if they believe they will be generating earnings that exceed the Earnings Test Limit. Those who are initially not aware that their benefits withheld due to the Earnings Test are not lost, may learn about this feature of Social Security when discussing the consequences of continuing to work or re-entering the labor market on a job that generates earnings above the limit with their claim specialist or upon inquiry after receiving fewer monthly benefit checks.

[17] A beneficiary may receive a partial monthly benefit at the end of the tax year if there are excess earnings that do not completely offset the monthly benefit amount (see SSA-H, §1806).

[18] Social Security claim specialists emphasized to us that during the first year after claiming they do what is most advantageous to the claimer, the monthly or the yearly test, if they have enough information. However, they failed to clarify what that means, some of them said the number of checks individuals receive is maximized, but we were unable to find documentation of such practices. In any case, the internal operating instructions used by Social Security field employees when processing claims for Social Security benefits state that the monthly earnings test only applies for the calendar year when benefits are initiated unless the type of benefit changes (see SSA-M, RS02501.030).

3.4 Hypothesis and Identification Strategy

The ability to affect the reduction factor even after claiming and the fact that the adjustment to the rate only occurs after reaching the NRA has important implication for labor force exit behavior. For those who claimed before the NRA ("early claimers"), continuing to work or returning to work and earn above the annual Earnings Test Limit ($11,640 in the years before reaching the NRA $31,080 for the time between January and the month when the NRA is reached in the year thereafter) is the only way to achieve a higher permanent benefit rate after the NRA. Someone who has not yet claimed benefits ("non-claimer"), on the other hand, can affect his or her rate of future benefit pay independently of working simply by continuing to not claim benefits. While the reduced benefit rate is approximately actuarially fair for individuals who claim and withdraw from the labor force at the same time (or earn below the Earnings Test Limit after claiming), it is not for individuals who claim early, have a working spell that results in (some) benefits withheld due to the Earnings Test and then retire or earn below the limit prior to reaching the NRA. Since the benefit rate is not adjusted for the months when no benefits were received prior to NRA, the lifetime benefits of early claimers who continue to work after claiming would only be actuarially fair relative to non-claimers if all benefits were withheld before the NRA. In other words, for early claimers who continue working and earn above the limit, hence see their benefits withheld, Social Security benefits received before the NRA become increasingly actuarially unfair with the number of months benefits were withheld compared to those who have not claimed at that time or those who claimed and retired immediately.

If the option to adjust the reduction factor even after claiming benefits by working and earning above the earnings limit to have benefits withheld, and the incentives provided by the increasingly actuarially unfair adjustment rules for those who claim and continue to work or return to work

matter, we expect to see those who have claimed benefits withdrawing from the labor force in a different way than those who have not claimed benefits at the time.

Specifically, the increasingly actuarially unfair benefit level constitutes a (negative) income effect on labor supply. Consequently, we first predict that some of the early claimers who are working at the time when they claim Social Security benefits will participate in the labor market longer (in order to collect higher benefits later and to avoid reduced benefits at an unadjusted rate) than individuals in the labor force who have not claimed at that time. Secondly, there should be some early claimers who first exit the labor force but later re-enter who will also stay employed longer than non-claimers who re-enter. As discussed before, by continuing to work (or by re-entering the labor force) and earning above the Earnings Test Limit, early claimers can not only suspend the receipt of monthly benefits for a longer time, thereby trading off reduced benefits today for upwards-adjusted benefits after reaching the NRA, but also avoid receiving the unadjusted benefits before the NRA which are (increasingly) actuarially unfair. Since the ability of a labor force participant who has not claimed at the time to achieve a greater future rate of benefit pay is not tied to earnings (thus working) and the reduction in benefits she faces is approximately actuarially fair, non-claimers are expected to exit the labor force at a baseline rate that is, on average, greater than the exit rate of early claimers who work after claiming. As the duration since early benefit initiation increases the incentives further predict that early claimers are increasingly likely to continue working (i.e. increasingly less likely to exit) compared to non-claimers.

The identification strategy presented above relies on the variation in claiming and working behavior. Specifically, our identification of the incentives of the adjustment of the rate of benefit pay after claiming provided by the current rules of the Earnings Test and the ARF, relies on the variation in the length of working spells of early claimers and later claimers. The latter includes both individuals who claim at a reduced rate but closer towards the NRA or those who claim at NRA or

thereafter. Given that the reduction in benefits associated with early retirement is actuarially fair for the average individual (average life expectancy) it is clear that early claiming and continuation of work or return to work will be less prevalent behavior than claiming and withdrawing at about the same time. And in fact, the evidence from the HRS provided in Figure 1 demonstrates such a pattern. However, Figure 1 also shows a sizable percentage of early claimers continue to work as discussed above.

There are several motivations for claiming benefits at or after age 62 while continuing to work or expecting a return to work, since having filed for benefits provides a type of insurance: (a) Individuals who face uncertain job prospects or uncertain income streams in general (and those who are more risk averse) may file for Social Security benefits as soon as they are eligible to secure benefit payments if needed. Processing the initial Social Security claim takes up to 3 months. Reinstating the monthly payments takes around 6 weeks. Also, in most states unemployment benefits are not deducted from Social Security benefits and vice-versa, i.e. unemployment benefits and Social Security benefits can be received at the same time. (b) With the ongoing debate about reforming the Social Security system, individuals eligible for early retirement benefits may become claimers even though they do not plan to withdraw from the labor force. Their motivation is to insure that they cannot be made worse off by subsequent changes to the Social Security system.

Given that the full incentive scheme provided by the Earnings Test and the ARF are fairly complex it is unlikely that all older Americans are aware of them. Benítez-Silva and Heiland (2005) estimate that no more than 30% of older Americans may know about these incentives suggesting that it may be difficult to draw inference about them. However, even if individuals are initially (e.g., before or even at the time of claiming) unaware that they can affect their benefit reduction factor after claiming or are misinformed about the incentives provided by the Earnings Test, they may learn about these incentives and may exercise the option to reverse the early retirement penalty

as: (a) they realize that the reduced rate is not sufficient to achieve the current or future desired standard of living, (b) their preferences for leisure or consumption changes, and (c) the opportunity costs for leisure increase, for example as a result of a job opportunity that yields earnings above the Earnings Test Limit. In each case, some individuals may continue a working spell after claiming or return to the labor market, earn above the limit to affect the reduction factor and be more likely to stay in the labor force as the time since claiming and before the NRA increases and the monthly benefits at the reduced rate become more actuarially unfair.

The theoretical discussion suggests that, on average, early claimers should exit the labor force more slowly than non-claimers and that the difference in the dropout rate between the two widens as the number of months since benefit initiation but before the NRA increases. To test for this potential non-linear effect of the time since benefit claiming on labor force participation, we analyze the exit hazard of Americans of early retirement age conditional on the time since benefit claiming. Two issues that need to be addressed in the empirical analysis of our hypothesis are individual-specific factors that may independently affect a person's risk of labor force exit, and the potential endogeneity of claiming behavior. Failure to control for such independent factors, and failure to account for the possibility that individuals consider the optimal timing of the benefit claiming when choosing the working spell after age 62 (or after they returned to the labor force), may at best obscure the interpretation of the effect of the duration since claiming on labor force exit and at worst lead to biased estimates.

As shown in greater detail below, we address the first concern by controlling for a large set of background characteristics of the individual including time-varying covariates and measures of physical and mental health and subjective survival probability. If the covariates proxy well for differences in the determinants of individual's labor force exit risks including tastes and endowments (health and cognitive ability), the estimated effects are more likely to capture the predicted

effect of time since claiming on a person's labor force participation risk. We also comment on results of specifications that model a common form of unobserved heterogeneity directly in the hazard function ("Frailty Model", see Vaupel et al. 1979).[19] To address the potential endogeneity of the timing of benefit claiming on the labor force participation spell, we use Lillard's (1993) simultaneous equations for hazards approach.

4 Data and Econometric Models

In this section we present the samples and measures used in the empirical analysis and the econometric models we estimate in section 5.

4.1 Data Description and Summary Statistics

Using monthly employment data of 7,203 men and women from the first five waves of the Health and Retirement Study (HRS), we construct measures of the time-to-exit from the labor force for individuals who are employed continuously from age 62 ('Exit-Sample') and those who exit the labor force after re-entering sometime after 62 ('Re-Exit-Sample').[20] We also construct monthly indicators of claiming behavior which—given data limitations—reflect the month the individual started receiving Social Security Old Age benefits.[21]

[19] Unobserved heterogeneity in survival analysis is particularly problematic. If some individuals are more at risk to exit the labor force due to an unobserved characteristic, then the group of individuals remaining in the labor force tend to be a selected group with lower exit risk. What we interpret as evidence for a causal relationship between the time since an individual initiated benefits and her risk of dropping from the labor force may be the result of differences in the proneness to exit the labor force across individuals, if no effort to account for observed and unobserved heterogeneity is made.

[20] Within the group of individuals whose status changed from employed to not employed ('exited'), we do not distinguish individuals who became unemployed, since the fraction of respondents exiting due to unemployment is less than 2% in the relevant age group.

[21] Given the structure of the questions in the HRS we are unable to verify whether the respondent continuously receives benefits. If none of the respondents in the sample had their benefits withheld our identification strategy, as explained in the previous section, should fail to capture any effect of the time since claiming on labor force exit.

Given our research question we do not follow individuals past the month of their 65^{th} birthday. The employment spell for individuals who have not withdrawn from the labor force prior to that month will be right-censored.[22] Subjects with missing data that imply left-censoring are dropped. For the exit sample the observed spells start from the month of the respondent's 62^{nd} birthday (minimum age of eligibility for early retirement). In the case of re-entrants to the labor market, we consider the first employment spell after a non-working spell that includes the month of the 62^{nd} birthday.[23] To illustrate how the samples are obtained, we note that of the 7,203 individuals in the HRS who are 62 or older, 3,381 have a complete work history after turning 62, and among those the 1,723 individuals who are working at 62 constitute our exit sample. As for the re-exit sample, we find that there are 477 individuals with complete work history who re-enter the labor market after 62.

The frequency distributions of the employment spells in both samples are shown in Table 1. We observe that in the exit sample males have longer working spells than females, and that claimers have slightly longer spells than non-claimers. The latter is due mainly to the fact that non-claimers are likely to be younger and therefore more likely to be censored.

In the re-exit sample there are no differences between males and females in the length of the working spell. On the other hand, claimers appear to have shorter employment spells after re-entering the labor force. However, this unconditional analysis does not take into account the censoring probability, which is correlated with the age of the respondent. The duration models below are able to account for this.

[22] Since we use data up to the year 2000, the NRA for most individuals in our samples is 65. Only individuals who turn 62 in 2000 have the higher NRA of 65 and 2 months. It is clear that the latter individuals are right-censored (or have completed the employment spell) before reaching their NRA in our samples.

[23] In this paper we do not extend the analysis to multiple spells. Notice that this could be done in two ways. (a) The two samples that are used separately in this paper can be combined into one. In that case some individuals experience two exit spells. (b) One can include higher order exit spells of individuals from the second sample.

Table 2 provides summary statistics for the earnings and hours of work in the calendar year corresponding to each month of the event of work/not work, claim/not claim in the exit and re-entrant sample. Males have higher earnings on average, and so do non-claimers. Claimers have earnings higher than the limits of the Earnings Test, which suggests that the average claimers who work might seek to increase the rate of future benefit pay, i.e. increase the ARF. This does not seem to be the case for the claimers who re-enter the labor force. Notice, however, the large standard deviations of the earnings measures, suggesting that there are a substantial number of individuals below the Earnings Test Limit also in the exit sample. The distribution of average hours of work is consistent with the earnings distribution.

As shown in Table 3 our sample consists of single employment-spell data on individuals who turn 62 between 1992 and 2000. We employ a large set of explanatory variables. To construct the time-varying covariates we assign characteristics from the closest previous survey wave available in each month. The sample of all employed individuals at age 62 ('Sample 1' or 'Exit-Sample') consists of 1,723 individuals with 24,097 person-months observed. The sample of all re-entrants ('Sample 2' or 'Re-Exit-Sample') consists of 438 individuals with 3,106 person-months observed.

To capture the effect of the incentives provided by the benefit rate adjustment process in the decision of when to exit the labor force we include time since claiming and the time before claiming in the exit hazard. To distinguish those who have not claimed yet in a particular month we construct a dummy variable, *Not Claimed Yet*, that equals 1 if the month is prior to becoming a claimer and 0 otherwise. We also include an indicator for the month when benefits are initiated.

We expect that—on average—the labor force exit hazard will be higher for individuals who have claimed benefits than for those who have not, as many individuals claim at the time they retire, or soon afterwards, once they reach age 62. Thereafter, we expect—for the reasons explained above—that time since claiming exhibits positive duration dependence on the working hazard, i.e.

the longer someone who has claimed benefits early stays in the labor force the smaller her exit hazard becomes compared to someone who has not claimed at the time, holding everything else constant. To capture this potentially non-linear effect the exit hazard models include a linear and a quadratic term for the time since benefits were claimed.

Furthermore, the incentives provided by Social Security suggest that the later individuals initiate benefits after turning 62 the less incentive they have to stay in the labor force to affect the reduction rate associated with claiming early. In other words, we expect a positive relationship between the number of months since 62 and before claiming benefits, and the exit hazard.

To be able to identify the hypothesized non-linear effect of time since claiming on labor force exit, we control for a large set of factors that are expected to influence the labor force exit decision independently of the time since claiming, such as measures relating to financial constraints, health limitations, opportunity costs, and tastes.[24] As proxies of a person's market earnings power we use measures of educational attainment, cognitive ability and work-related health limitations as reported in Table 3. Together with marital status and subjective life expectancy, poor health may also capture leisure preferences. The availability and type of health insurance, pension wealth, and asset wealth are expected to play an important role in the decisions of when to withdraw from the labor force. Hence we have constructed an indicator for individuals without health insurance (non-missing for 84-88% of the respondents in the samples) and for those with private health insurance (84-88% non-missing). The individual's wealth during this part of the life cycle is measured by net total household wealth (77-83% non-missing), and an indicator for whether they have a private pensions (97-99% non-missing). Using the restricted earnings data from the HRS we have constructed a person's PIA, i.e. a measure of the respondent's actuarially fair Social Security wealth

[24] We follow standard specifications used in the empirical literature on labor supply of older workers (see e.g., Lumsdaine and Mitchell 1999).

based on their history of earnings (79% non-missing).[25] The PIA is potentially important—in conjunction with private pensions and net (non-pension) wealth—not only as a control for wealth in the labor supply decision but also to understand the claiming behavior as investigated in the simultaneous hazard model below.

4.2 Single Equation Models

To empirically assess the role of the incentive to continue working provided by the penalty adjustment mechanism in the retirement decision between ages 62 and the NRA, we estimate hazard models of labor force exit (or 'time-to-exit models'). As discussed above, the effects are identified by the variation in behavior found in the data between early claimers (before the NRA) and later claimers, controlling for other determinants of an individual's proneness to withdraw from the labor market in a given month.

Let T_i denote the duration of employment of individual i. The log-survival time model of employment is:

$$\ln T_i = X_i'\beta + \sigma\varepsilon_i, \tag{4}$$

with error $\sigma\varepsilon_i$ and observable covariates X_i. Among the regressors we include measures of the individual i's claiming behavior. For example, if we include the time since claim initiation as the j^{th} covariate, $X_{i,j}$, then our hypothesis that earlier claimers stay employed longer (i.e. have a greater survival time T) than later claimers, implies that $\beta_j > 0$. Given that we have censoring in the employment data we estimate the claiming effects from labor force exit hazard models.

[25] The restricted earnings data provide the history of earnings for the 9,472 individuals, as of the first wave of interviews, that gave permission to link their files, from 1951 to 1991. Haider and Solon (2000) find little evidence of non-randomness and lack of representativeness in this sub-sample of individuals. The PIA we include in our estimations uses these histories and then imputes earnings up to the individuals' 62^{nd} birthday in order to calculate the retirement benefits as of that age. For the months after that we just use the monthly actuarial adjustment factor.

We present results using a piece-wise linear baseline hazard specification building on the Gompertz proportional hazard model. This approach yields a very flexible specification of the baseline duration dependence pattern:[26]

$$h_i(t) = exp\left(T(t)'\gamma + X_i'\theta\right), \tag{5}$$

where γ is a vector of (slope) coefficients associated with a vector of linear spline variables, $T(t)$. The spline variable for the k^{th} interval between λ_{k-1} and λ_k is given by

$$T_k(t) = max[0, min(t - \lambda_{k-1}, \lambda_k - \lambda_{k-1})].$$

In particular, in the Gompertz model shown below, where we use nodes at 3 months, 6 months, 12 months, and 36 months (i.e. $\lambda_1 = 3$, $\lambda_2 = 6$, $\lambda_3 = 12$, $\lambda_4 = 36$, $\lambda_5 = \infty$) the baseline duration spline is[27]

$$T(t)'\gamma = \sum_{k=1}^{5} \gamma_k \cdot T_k(t).$$

It is important to understand that this baseline duration pattern captures the average effect of time after age 62 on the exit hazard based on all individuals. With the inclusion of the time since claiming measures we capture the potential differential effect that the time passed since the claiming date may have on early claimers' risk of exiting, controlling for other factors including the effect of time since age 62 captured by the baseline duration pattern. The estimation of the model is conducted using aML (Lillard and Panis 2003).

[26] We have conducted extensive sensitivity analysis of the functional form of the baseline exit hazard, by assuming different distributions for the ε. We have re-estimated our single equation models assuming that ε is extreme value type II distributed then the hazard function for labor force exit takes the known Weibull form. To contrast the results from the Weibull hazard model with a functional form that allows for non-monotonic baseline duration dependence, we have also estimated specifications based on the log-normal hazard function by assuming that the error term of the log survival time, ε, follows the normal distribution. The estimation results assuming these different distributions do not change the findings we will present in any significant way. In order to simplify the exposition of the results we have decided not to report those additional estimation results, but they can be obtained from the authors upon request.

[27] Due to the comparatively small number of observations, in the re-exit sample we have only been able to identify four nodes for the baseline duration spline for this group, at 3, 6, 12, and more than 12 months.

In an alternative specification, shown in the columns labeled (2) in Table 4, we have added a *Time Before Claiming* measure (in months) and its square. If the incentives due to the ARF matter, we expect the *Time Before Claiming* to increase the likelihood of exiting the labor force.

We make several attempts to minimize the potential influence of unobserved individual-level differences in the exit hazard. Omission of variables that relate to the individual's risk ("Frailty") of experiencing an event (labor force exit or benefit claiming) may lead to biased estimates (see Struthers and Kalbfleisch 1986 and Gail et al. 1984). We first attempt to address this concern by controlling for a large set of background characteristics of the individual in all specifications. These characteristics include, educational attainment, health, cognitive ability, subjective survival probability, finances, etc. If these covariates proxy well for differences in individuals' ability, tastes, and endowments, the estimated claiming coefficients are more likely to reflect the underlying effect of the incentives on labor supply. Since it is difficult to assess the reliability of these variables as proxies, we also estimate Weibull and Log-Normal mixture models that explicitly account for unobserved heterogeneity by including a random effect in the hazard function. These parametric frailty models have the form: $h_i(t|\alpha) = \alpha \cdot h_i(t)$ (see Vaupel et al. 1979). They arise from a multiplicative random heterogeneity effect, α, which is assumed to follow a mean-one and finite-variance θ distribution. Individuals with $\alpha > 1$ are said to be more prone to exit the labor market than others for reasons not explained by the covariates. We consider the case where the α is a Gamma random variable (with parameters $1/\theta$ and θ). Models of this type can account for unobserved individual-level differences in the exit risk of an individual including differences in attachment to the labor force, knowledge about the adjustment process, or the degree of risk aversion.

4.3 Simultaneous Hazards Model

A potential concern with the single equation models is that the risk of claiming benefits and the risk of withdrawing from the labor force are jointly determined. It is likely that individuals consider the optimal timing of benefit claiming when choosing whether to continue working after age 62. In that case, the risk of claiming at some month and variables derived from this outcome, which include our main variable of interest, the time since claiming, may not be exogenous in the working hazard. They may be subject to the same unobserved characteristics (such as tastes and endowments) that affect the length of the working spell. For example, some individuals may have above average attachment to the labor force for reasons unrelated to the incentives provided by the benefit adjustment rules (e.g. since they are initially in a job that is a particularly good match). If they are also more likely to claim benefits early (e.g. since they are also particularly risk averse) an estimated negative effect of the time since claiming on the exit hazard may reflect their unobserved motives for delaying exit after claiming rather than the incentives provided by the early retirement rules of Social Security. To address potential problems of unobserved heterogeneity in exit risk that are transmitted via the outcome of the claiming process, we estimate the claiming and the labor force exit process jointly, allowing for unobserved components in each process, and the possibility that these determinants are correlated.

Our estimation approach is based on the full information maximum likelihood 'simultaneous equations for hazards' model of Lillard (1993).[28] This approach assumes that the duration processes may be correlated via individual-specific unobserved heterogeneity components that follow a bivariate normal distribution. Specifically, we estimate the following system of labor force exit

[28] The framework is commonly adopted to estimate multiprocess duration problems. This methodology has been applied, for example, to study the determinants of welfare participation, family formation and resolution, and education (see Brien and Lillard 1994, Brien et al. 1999, Upchurch et al. 2002, and Fitzgerald and Ribar 2004, among others).

and claiming hazard equations

$$h_i^E(t) = exp\left(T_E(t)'\gamma_1 + X_{Ci}(t)'\,\beta + Y_{1i}(t)'\theta_1 + \varepsilon_E\right), \tag{6}$$

$$h_i^C(t) = exp\left(T_C(t)'\gamma_2 + X_{Ei}(t)\,\delta + Y_{2i}(t)'\theta_2 + \varepsilon_C\right), \tag{7}$$

where the baseline duration patterns in both equations are allowed to be different, and the exogenous control variables, Y_1, Y_2 can be the same. As in the single equation models above, X_{Ci} contains measures that capture the effect of claiming on the exit from the labor force. In the baseline specification we control for whether a person has *Not Claimed Yet* in a given month, and conditional on that, the *Month when Claimed*, the *Time Since Claiming* was initiated (in months), and its square. We note that we also allow the claiming hazard to depend on the outcome of the labor force participation process via X_E.

The joint probabilities of observed outcomes and events (claiming dates, exit dates, completed or censored) conditional on the vector of unobserved heterogeneity components (ε_E, ε_C) is the product of the individual conditional probabilities (say, $L_{i,E}(\varepsilon_E)$ and $L_{i,C}(\varepsilon_C)$ for individual i) since they are statistically independent.[29] Consequently, the contribution to the joint likelihood of individual i's complete set of outcomes is the integral of the joint conditional likelihood over the range of the jointly normal heterogeneity components. That is,

$$L = \int_{\varepsilon_E}\int_{\varepsilon_C} \frac{\phi(\frac{\varepsilon_E}{\sigma_{\varepsilon_E}}, \frac{\varepsilon_C}{\sigma_{\varepsilon_C}}|\rho_{\varepsilon_E\varepsilon_C})}{\sigma_{\varepsilon_E}\sigma_{\varepsilon_C}} \times \Pi_{i=1}^{Nind}(L_{i,E}(\varepsilon_E)L_{i,C}(\varepsilon_C))d\varepsilon_E d\varepsilon_C. \tag{8}$$

The coefficient vector is estimated using the aML Multiprocess Multilevel Modeling software (Lillard and Panis 2003). Estimation of this type of multiprocess hazard model using single spell data is difficult. In the estimation of our sample we only identify the correlation coefficient. The variances of the two unobserved heterogeneity terms are set to unity.[30]

[29] The heterogeneity this procedure allows us to control for is individual-specific. Notice that any unobserved heterogeneity due to transitory shocks, beyond those captured by our time controls, cannot be identified with this approach.

[30] We note that identification of the variance components has been shown theoretically (Heckman and Honoré

5 Empirical Results

5.1 Single Equation (Re-)Exit Analysis

Single equation estimation results for the exit and the re-exit sample are presented in Table 4. Specification (2) in the table, differs from specification (1) in that the former also controls for the duration between the time of the 62^{nd} birthday and the claiming of benefits. All models include a large set of covariates that control for socio-economic background and health characteristics of the individual. Also included—but not shown in the table—are a set of indicators for region of residence and calendar year of the 62^{nd} birthday. In the table a positive coefficient indicates an increased hazard, or higher likelihood of dropping from the sample of workers. As discussed above, we have also estimated Weibull and Log-Normal frailty models to control for unobserved heterogeneity. Since the results suggest that there is no evidence that the exit hazard models are misspecified due to omitted covariates we decided not to report them here.[31]

Exit Model

For the two specifications shown in Table 4, the *Time Since Claiming* variable has the sign hypothesized and is statistically significant. The longer it is since someone has claimed early benefits, the more likely they are to stay in the labor force compared with someone who has not claimed benefits at that time. The square term is positive and significant, indicating that the exit hazard decreases at a decreasing rate in the number of months since claiming. The net effect of time since claiming is negative, indicating a lower likelihood of dropping out of the labor force, which supports the

1989).

[31] The coefficients and standard errors in the exit models with frailty were almost identical and the variance of the heterogeneity component was close to zero. The results are available from the authors upon request. The re-exit models did not converge using the Gamma frailty which is likely to be the result of the small sample size.

importance of the incentives provided by the rules regarding the adjustment of the reduction factor. Notice the large effect that the indicator of not having claimed yet has on decreasing the likelihood of dropping from the labor force. This control is necessary to account for the level shifter that indicates that those who have not claimed as of that month are unconditionally more likely to participate in the labor market. The sizable coefficient captures the increased exit probability associated with becoming eligible for early retirement benefits after turning 62 typically found in studies of retirement behavior during the 1990s. Also consistent with the fact that many early claimers retire when they claim, the indicator of month of claim increases the retirement hazard, which indicates that a number of respondents retire in the same month they claim benefits.

A number of other coefficients have the expected sign, with higher wealth decreasing the hazard, and the presence of private pension or a higher primary insurance amount (public pension) increasing the hazard.[32] We also find that if the respondent is the primary respondent (the financially knowledgeable person in the household), he or she is less likely to withdraw from the labor force. The health insurance variables we include, lack of health insurance, and having private insurance, have mostly insignificant effects across specifications. Not having health insurance has the expected negative effect on dropping from the labor force, but this coefficient is very imprecisely estimated.[33]

We also identify the indicators for the piece-wise linear baseline duration pattern of labor force

[32] We observe a stronger and statistically significant effect of private pension on the exit hazard across specifications if the PIA is excluded from the model (results available from the authors upon request), which suggests that the reported estimates of the pension effects may be subject to multicollinearity since individuals with high PIAs are also likely to have private pensions. In any case, the pattern of the claiming effects is robust to the pension specification. The effect of private pensions—if the PIA is not included—is consistent with the interpretations a number of researchers make of the fact that a considerable number of individuals are not working after age 62 but at the same time are not claiming benefits. A number of pension plans penalize individuals who receive Social Security benefits while accumulating pension balances, in other cases individuals prefer to wait to receive their full PIA while supporting themselves on their pensions. We thank John Sabelhaus for helping us understand this issue.

[33] Currie and Madrian (1999) provide a review of the literature on the effects of health insurance on labor market decisions.

exit behavior. For this sample of respondents all those duration indicators are significant and depict an interesting pattern, which shows that during the first three months after turning 62 there is an increased hazard of exit from the labor force, followed by a decreased hazard in months 3 to 6 after the 62^{nd} birthday. The hazard again increases for months 6 to 12, and decreases for durations between 1 and 3 years. Finally, for those reaching their 65^{th} birthday there is a large and significant increased hazard of exiting the labor force in the month they turn 65 and the month after, an effect consistent with the traditional observed retirement peak at that age.

The second specification for the *exit sample* adds an indicator of *Time Before Claiming* and its square, a variable that indicates the number of months between age 62 and the time of claiming. The coefficient on the linear term has the hypothesized positive effect on the hazard, since longer durations before claiming indicate an increased likelihood of retirement compared with those that have claimed. The square term has a negative effect on the probability of exiting the labor force due to the fact that a significant number of individuals claim benefits around their 65^{th} birthday. The remaining results are essentially unchanged.

Re-Exit Model

In this case the estimates are quite noisy and almost none of the coefficients of interest is statistically different from zero. The small number of observations seems to be the main problem here. We conclude from this that possibly an analysis with multiple spells, and a separate examination of the determinants of re-entry might be appropriate to clarify the importance of the emphasized incentives in this population.

5.2 Simultaneous Analysis of Exit and Claiming

Table 5 shows the results of estimating the claiming and the exit hazards simultaneously using the exit sample and following the identification strategy described in Lillard (1993).[34] In the first set of results the exit hazard includes the same variables as specification (1) in the single equation models. The second model includes a variable that captures the fraction of the year before turning 62 that a respondent participated in the labor market. We include this measure to assess if the results are driven by individual heterogeneity with regard to labor force attachment. The results of both models are essentially the same.

The main results do not differ much from those of the single equation analysis, even though the correlation coefficient between equations is estimated to be positive, large, and significantly different from zero. The coefficient of the *Time Since Claiming* measure is marginally larger in absolute value in the joint estimation than in Table 4, suggesting that there is little evidence for simultaneity bias in the time since claiming measures. While the difference in the effect is small, the statistical significance of the correlation coefficient is some evidence in support of the joint estimation strategy. Its positive sign is consistent with the presence of unobserved characteristics of the individual that affect the exit and claiming behavior in a similar way. While we cannot identify the exact nature of these characteristics we suspect they are mostly related to productivity and health differences across individuals that are not captured otherwise.[35] After controlling for the previous attachment to the labor force the correlation weakens somewhat indicating that this variable is an important determinant that affects the exiting and claiming probabilities in the same

[34] We did not find the results reported below to be sensitive to considering specifications where some exclusion restrictions (more or less difficult to defend) are made. Given that the estimates below support the evidence we have presented throughout the paper, we argue that the structural assumptions imposed in the estimation of the bivariate hazard model do not buy us the main results of this research, but rather show the robustness of those results.

[35] We have conducted extensive sensitivity analysis regarding the variances of the unobserved components in equations 6 and 7 using a grid search approach. The correlation coefficient is in all cases positive and significant, and the remaining coefficient estimates are not substantially different from those reported in Table 5.

(negative) way.

We can observe that, other things equal, an early claim of benefits decreases the hazard of dropping from the labor force, a result consistent with a significant effect of the labor supply incentives represented by the ARF. As in the single-equation models, the dropout risk increases after claiming and the greatest increase occurs soon after claiming as shown by the negative coefficient on the linear term and the positive coefficient on the quadratic. The model predicts that an individual who has claimed benefits in a particular month is about 21.1% less likely to drop from the labor force in the following month than an individual who has not claimed benefits and is still in the labor force.[36] An individual who claimed benefits 6 months ago is about 71.1% less likely to drop from the labor force a month later than an individual who has not claimed benefits and continues to work. This percentage goes up to 87% if the individual claimed benefits a year ago.

We again observe the negative effect on the hazard of being the primary respondent and having more wealth. This negative effect can also be observed for those with higher self-reported probabilities of living to age 85, suggesting a coherent effect of self-assessed longevity. Having a health limitation, as we saw in the single equation model, has a positive effect on the hazard of exiting the labor force. As before we observe the expected positive signs of the effect of the primary insurance amount and of having a private pension in the labor force exit hazard. However, these effects are not statistically significant at the 10% significance level.

Regarding the baseline hazard we observe that, as in the Gompertz model, in the three months after turning 62 the retirement hazard increases, but decreases in the 3 to 6 months period, and increases again in the 6 to 12 month period. In this case the hazard keeps increasing after that, and is especially high at the time the individual turns 65 and the month after. This overall pattern

[36] From Table 5 we use -0.243 and compute the percentage increase in the probability as $100 \cdot (\exp(-0.243 + 0.006) - 1)$.

replicates fairly well the known retirement peaks described in the literature.

Turning to the claiming hazard, continuous participation in the labor market reduces the likelihood that someone will claim benefits. Being the primary respondent increases the likelihood of claiming, but higher wealth and a higher score in a cognitive test decreases the claiming hazard. The wealth effect is consistent with the widely accepted believe that wealth proxies for a variety of characteristics likely to be correlated with delayed retirement, and it is also consistent with the fact that poorer individuals receive higher replacement rates from the social insurance system. The results also show that the primary insurance amount plays a more important role in the claiming than in the labor force participation decision. As expected, a higher PIA increases the likelihood that claiming of benefits is initiated at that time. Interestingly, the duration patterns for the claiming behavior in the months after age 62 matches the pattern in the same months for the exit hazard, with an increase in the first 3 month, a decrease in months 3 to 6, and an increase afterwards, with a clear peak around the person's 65^{th} birthday.

In addition to investigating the robustness of the claiming effects by looking at different baseline hazard specifications and by controlling for the endogeneity of claiming as presented above, we have also considered alternative specifications for all models presented in Tables 4 and 5.[37] In addition to re-estimating all models controlling for labor supply during the 12 months period before the individual's 62^{nd} birthday, as shown in Table 5 for the joint model, we have also included a dichotomous variable for self-employment status. While the effect of previous labor supply on the labor force exit hazard has the expected negative sign, the effects of claiming on employment tend to be unchanged. Furthermore, while self-employed individuals are significantly less likely to drop out of the labor force, the qualitative pattern of the claiming effects is unaffected by controlling for self-employment status.

[37] These results are available from the authors upon request.

6 Conclusions

This paper analyzes the effects of the incentives set up by Social Security regarding claiming of benefits and working, which individuals face between the Early Retirement Age and the Normal Retirement Age. These incentives have been largely ignored by researchers focusing on the retirement decision, and have not been analyzed in a framework that allows for the simultaneity of the decisions to start receiving benefits and working.

We have presented evidence for the presence of positive duration dependence of employment associated with claiming benefits early. The labor supply incentives of the Social Security system for those that claim benefits early have real and sizable effects in a sample of individuals from the Health and Retirement Study. This result is found consistently across single equation models of labor force exit and joint models of exit and timing of benefit claiming.

Given that the option to affect the reduction factor even after claiming benefits early investigated in this study may not be a very well-known feature of Social Security, our evidence of their importance for behavior based on data from the Health and Retirement Study may be a lower bound estimate of their potential effect on retirement behavior if they were made better known. In particular our findings suggest that we can expect more benefit claiming and greater participation before the NRA if the percentage of individuals who understand that benefits withheld due to the Earnings Test are not lost but will increase the rate of future benefit pay were to rise.

It is clear that, as the population ages, and the number of years between the Early and NRA increases over time, the incentives provided by the Actuarial Reduction Factor and the Earnings Test will be even more important since all current and future retirees experience a greater reduction of benefits when claiming early. Some recent remarks by influential (but independent) policy makers in the U.S., like Alan Greenspan, indicate that the NRA is likely to increase even further in

the next few years in order to avoid even more radical (and painful) changes to Social Security. As the NRA rises, having the option to affect the reduction factor after claiming early becomes more valuable to individuals. Since the adjustment of the benefit rate typically takes place only after the NRA is reached, benefits received before the NRA may become increasingly actuarially unfair for those who continue to work after claiming in the next years. As a result future cohorts that reach ERA and consider their options regarding working and benefits will find information regarding the adjustment of the reduction factor increasingly useful. For that reason, the Social Security Administration should consider providing additional information about the Actuarial Reduction Factor, such as an updated version of the benefit calculator, and more direct information on their webpage and the many important details regarding these important policies.

Finally, one of the objectives of this paper is to foster further research on the importance and behavioral consequences of work after claiming benefits, and the option to affect the reduction factor after claiming. A natural extension is to assess in a dynamic framework the importance of the incentives provided by the ARF in conjunction with the Earnings Test. This type of model will also allow researchers to analyze what the potential impact of these incentives is in the presence of a variety of policy reforms to the U.S. social insurance system, such as changes to the early and NRA, changes in the actuarial adjustment, changes in the Earnings Test, or the possibility of strengthening the link between Social Security taxes and Social Security benefits through the investment of part of the payroll taxes in individual accounts. A dynamic framework would also help to assess the impact of these incentives provided by the social insurance system on the wealth accumulation and retirement planning behavior of older Americans.

References

Baker, M., and D. Benjamin (1999): "How do retirement tests affect the labor supply of older men?" *Journal of Public Economics,* **71** 27–51.

Benítez-Silva, H., and F. Heiland (2005): "The Earnings Test Revisited: Information, Distortions and Costs," manuscript, SUNY-Stony Brook.

Brien, M. J., and L. A. Lillard (1994): "Education, Marriage, and First Conception in Malaysia," *Journal of Human Resources,* **29** 1167–1204.

Brien, M. J., Lillard, L. A., and L. J. Waite (1999): "Interrelated Family-Building Behaviors: Cohabitation, Marriage, and Nonmarital Conception," *Demography,* **36** 535–51.

Burtless, G., and R. A. Moffitt (1985): "The Joint Choice of Retirement Age and Post-Retirement Hours of Work," *Journal of Labor Economics,* **3** 209–236.

Coile, C., P. Diamond, J. Gruber, and A. Jousten (2002): "Delays in Claiming Social Security Benefits," *Journal of Public Economics,* **84-3** 357–385

Currie, J., and B.C. Madrian (1999): "Health, Health Insurance and the Labor Market," in Ashenfelter, O. Card, D. (Eds.), *Handbook of Labor Economics,* **Vol. 3C.**

Fitzgerald, J. M., and D. C. Ribar (2004): "Transitions in Welfare Participation and Female Headship," *Population Research and Policy Review,* **23** 641–670.

French, E. (2005): "The Effects of Health, Wealth, an Wages on Labour Supply and Retirement Behaviour," *Review of Economic Studies,* **72** 395–427.

Friedberg, L. (1998): "The Social Security Earnings Test and Labor Supply of Older Men," in *Tax Policy and The Economy,* Vol. **12.** MIT Press.

Friedberg, L. (2000): "The Labor Supply Effects of the Social Security Earnings Test," *The Review of Economics and Statistics,* **82** 48–63.

Gail, M. H., Wieand, S., and S. Piantadosi (1984): "Biased Estimates of Treatment Effect in Randomized Experiments with Nonlinear Regressions and Omitted Covariates," *Biometrika,* **71** 431–444.

Gruber, J., and P. Orszag (1999): "What To Do About the Social Security Earnings Test?" Center for Retirement Research Brief July 1999 No. 1.

Gruber, J., and P. Orszag (2000): "Does the Social Security Earnings Test affect Labor Supply and Benefits Receipt?" CRR Working Paper No. 2000-07.

Gruber, J., and D.A. Wise (2004): *Social Security Programs and Retirement Around the World: Micro-Estimation,* National Bureau of Economic Research.

Gustman, A. L., and T. L. Steinmeier (1991): "Changing the Social Security Rules for Work after 65," *Industrial and Labor Relations Review,* **44** 733–745.

Gustman, A. L., and T. L. Steinmeier (2002): "The Social Security Early Retirement Age in a Structural Model of Retirement and Wealth," NBER Working Paper No. 9183.

Gustman, A. L., and T. L. Steinmeier (2004): "The Social Security Retirement Earnings Test, Retirement and Benefit Claiming," Michigan Retirement Research Center No. 2004-090.

Heckman, J. J., and B. E. Honoré (1989): "The Identifiability of the competing risks model," *Biometrika,* **76** 325–330.

Haider, S., and G. Solon (2000): "Nonrandom Selection in the HRS Social Security Earnings Sample," RAND Working Paper No. 00-01.

Honig, M., and C. Reimers (1989): "Is It Worth Eliminating the Retirement Test?" *American Economic Review,* **79** 103–107.

Hurd, M. (1990): "Research on the Elderly: Economic Status, Retirement, and Consumption and Saving," *Journal of Economic Literature,* **28** 565–637.

Hutchens, R. (1999): "Social Security Benefits and Employer Behavior: Evaluating Social Security Early Retirement Benefits as a Form of Unemployment Insurance," *International Economic Review,* **40-3** 659–678.

Leonesio, M. V. (1990): "Effects of the Social Security Earnings Test on the Labor Market Activity of Older Americans: A Review of the Evidence," *Social Security Bulletin,* **53** 2–21.

Lillard, L. A. (1993): "Simultaneous Equations for Hazards: Marital Duration and Timing of Fertility," *Journal of Econometrics,* **56** 189-217.

Lillard, L. A., and C. W. A. Panis (2003), "aML Multilevel Multiprocess Statistical Software, Version 2.0," Econ Ware, Los Angeles, CA.

Lumsdaine, R. (1995): "Factors Affecting Labor Supply Decisions and Retirement Income," NBER Working Paper No. 5223.

Lumsdaine, R., and O. Mitchell (1999): "New Developments in the Economic Analysis of Retirement," in Ashenfelter, O., Card, D. (Eds.), *Handbook of Labor Economics*, Vol. **3C.** 3261–3307.

Myers, R. J. (1993): *Social Security.* Fourth Edition. Pension Research Council and University of Pennsylvania Press.

Reimers, C., and M. Honig (1993): "The Perceived Budget Constraint under Social Security: Evidence from Reentry Behavior," *Journal of Labor Economics,* **11** 184–204.

Reimers, C., and M. Honig (1996): "Responses to Social Security by Men and Women: Myopic and Far-Sighted Behavior," *Journal of Human Resources,* **31-2** 359–382.

Ruhm, C. J. (1996): "Historical Trends and the Future of Older Americans," in Crown, W.H. (Ed.), *The Handbook on Employment and the Elderly*, Greenwood.

Rust, J., and C. Phelan (1997): "How Social Security and Medicare Affect Retirement Behavior in a World of Incomplete Markets," *Econometrica,* **65** 781–831.

SSA-S (various years): Social Security Bulletin. Annual Statistical Supplement. http://www.ssa.gov/policy/docs/statcomps/supplement/.

SSA-H: Social Security Handbook. Online Version. http://www.ssa.gov/OP_Home/handbook/ssa-hbk.htm.

SSA-M: Program Operations Manual System (POMS). Public Version. http://policy.ssa.gov/poms.nsf/aboutpoms.

Struthers, C. A., and J. D. Kalbfleisch (1986): "Misspecified proportional hazard models," *Biometrika,* **73** 363–369.

Upchurch, D. M., L. A. Lillard, and C. W. A. Panis (2002): "Nonmarital Childbearing: Influences of Education, Marriage, and Fertility," *Demography,* **39** 311–29.

Vaupel, J. W., K. Manton, and E. Stallard (1979): "The impact of heterogeneity in individual frailty on the dynamics of mortality," *Demography,* **16** 439–54.

Votruba, M. E. (2003): "Social Security And Retirees' Decision to Work," manuscript, Case Western Reserve University.

van der Klaauw, W., and K. I. Wolpin (2005): "Social Security, Pensions and the Savings and Retirement Behavior of Households," manuscript, University of North Carolina-Chapel Hill.

Figure 1: Month Exiting and Claiming Decisions between age 62 and 65 (Source: Authors)

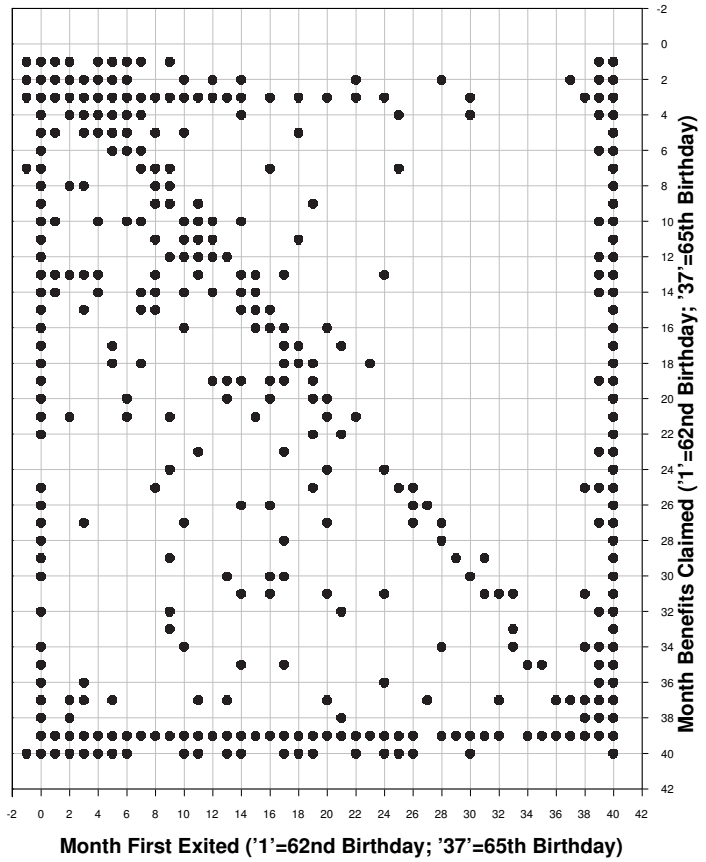

Table 1: Percentage Distribution of Working Spells

			Outcome	
Sample	**Total Number of Subjects**	**Mean Duration**[a]	**Not Working**	**Censored**
Worked at 62	1,723	14.0	36.7	63.3
Male	984	14.6	37.9	62.1
Female	739	13.2	35.2	64.8
Claimer[b]	474	14.5	53.0	47.0
Non-Claimer	1,249	13.8	30.6	69.4
Re-Exited after 62	438	7.1	39.5	60.5
Male	239	7.1	38.5	61.5
Female	199	7.1	40.7	59.3
Claimer[c]	211	5.5	33.2	66.8
Non-Claimer	247	7.9	41.7	58.3

Notes: [a]In months. [b]Ever benefit claimer. [c]Benefits claimed before reentry.

Table 2: Distribution of Earnings and Hours

	Earnings[a]		*Hours Worked*[b]	
Sample	**Mean**[c]	**Standard Deviation**	**Mean**	**Standard Deviation**
Worked at 62	23,626	32,550	1,320	830
	(18,474)		(21,699)	
Male	30,177	39,178	1,410	872
	(10,809)		(12,927)	
Female	14,388	15,598	1,188	746
	(7,665)		(8,772)	
Claimer[d]	16,406	27,143	1,050	785
	(5,264)		(6,167)	
Non-Claimer	26,503	34,046	1,427	824
	(13,210)		(15,532)	
Re-Exited after 62	9,149	17,382	735	641
	(2,129)		(2,574)	
Male	12,319	22,884	758	690
	(1,133)		(1,458)	
Female	5,545	5,094	704	571
	(996)		(1,116)	
Claimer[e]	5,786	5,581	547	491
	(802)		(982)	
Non-Claimer	11,182	21,332	851	693
	(1,327)		(1,592)	

Notes: [a]Average calender year earnings in current US-$. [b]Average calendar year hours worked. [c]Number of cases (person-months) in parenthesis. [d]Ever benefit claimer. [e]Benefits claimed before reentry.

Table 3: Means of Variables in Labor Market (Re-)Exit Analysis

Variable Name	Definition	*Mean*[a] Exit	Re-Exit
Subject-Invariant			
Male	1 if male, 0 otherwise	0.57 (1.00)	0.55 (1.00)
White	1 if white, 0 otherwise	0.78 (1.00)	0.80 (1.00)
No Diploma	1 if no high school diploma, 0 otherwise	0.68 (1.00)	0.68 (1.00)
Voc. Training	1 if vocational training received, 0 otherwise	0.23 (1.00)	0.25 (1.00)
BA	1 if Bachelor degree obtained, 0 otherwise	0.25 (1.00)	0.23 (1.00)
Prof. Degree	1 if professional degree obtained, 0 otherwise	0.09 (1.00)	0.08 (1.00)
Cogn. Test	Cognitive Ability Test Score (Scale: 0-14)	6.30 (0.90)	6.15 (0.92)
Worked Previously	fraction of months worked in the year prior to the 62 birthday	0.97 (0.96)	0.70 (0.90)
Others	9 regional dummies		
Sample Size[b]		1,723	438
Subject-Varying[c]			
Married	1 if currently married or living together, 0 otherwise	0.77 (0.85)	0.78 (0.89)
Primary Respondent	1 if respondent is the financially knowledgeable person, 0 otherwise	0.64 (0.86)	0.63 (0.89)
Month Claimed	1 if month when first received Social Security Benefits, 0 otherwise	0.02 (1.00)	0.01 (1.00)
Time since Claiming[d]	number of months since initiation of benefits	4.4 (0.28)	15.4 (0.37)
Pr. Living to 85	self-reported probability of living to age 85	0.47 (0.14)	0.45 (0.19)
Health Lim. for Work	1 if health limitations for work exist, 0 otherwise	0.09 (0.85)	0.18 (0.89)
PIA	nominal monthly primary insurance amount (PIA) (in $1,000s)	0.73 (0.79)	0.71 (0.79)
Net Wealth	total net household wealth (in $100,000s)	2.82 (0.83)	2.10 (0.77)
Private Pension	1 if has private pension, 0 otherwise	0.54 (0.99)	0.51 (0.97)
No Insurance	1 if no health insurance currently, 0 otherwise	0.06 (0.84)	0.12 (0.88)
Private Insurance	1 if has private health insurance, 0 otherwise	0.23 (0.84)	0.24 (0.88)
Hourly Pay	1 if job pays hourly, 0 otherwise	0.53 (0.20)	0.60 (0.16)
Hours Worked	total hours worked in the corresponding calendar year	1,320 (0.90)	735 (0.83)
Earnings	total earnings from wages in the corresponding calendar year	23,626 (0.77)	9,149 (0.69)
Sample Size[e]		24,097	3,106

Notes: [a]Mean for subject-varying variables is computed using the overall mean. Fraction of subjects with complete observations in parenthesis. [b]Data are based on the most recent available survey in each month. [c]Number of subjects (=respondents). [d]Excludes respondents who do not initiate benefits before age 65. [e]Number of subject-months.

Table 4: Piece-Wise Linear Labor Market (Re-)Exit Model

	Gompertz Model			
	Exit Hazard		**Re-Exit Hazard**	
Variable Name	**(1)**	**(2)**	**(1)**	**(2)**
Month Claimed	0.383**	0.361**	0.629	0.691
	(0.166)	(0.166)	(0.634)	(0.635)
Time since Claiming	**-0.237****	**-0.232****	**0.017**	**0.017**
	(0.037)	(0.037)	(0.056)	(0.057)
Time since Claiming Square	**0.006****	**0.005****	**-0.001**	**-0.001**
	(0.001)	(0.001)	(0.002)	(0.002)
Not Claimed Yet	-2.497***	-2.257***	-0.244	-0.146
	(0.168)	(0.170)	(0.428)	(0.445)
Time before Claiming		0.110***		0.026
		(0.015)		(0.042)
Time before Claiming Square		-0.004***		-0.001
		(0.000)		(0.001)
Male	-0.071	-0.071	0.022	0.034
	(0.106)	(0.108)	(0.221)	(0.226)
White	-0.061	-0.087	-0.275	-0.286
	(0.105)	(0.105)	(0.206)	(0.209)
BA	-0.104	-0.107	0.097	0.096
	(0.125)	(0.125)	(0.237)	(0.242)
Prof. Degree	-0.059	-0.050	-0.405	-0.424
	(0.189)	(0.190)	(0.473)	(0.479)
Married	-0.029	-0.031	0.089	0.085
	(0.135)	(0.140)	(0.274)	(0.276)
Primary Respondent	-0.488***	-0.503***	-0.199	-0.184
	(0.100)	(0.102)	(0.221)	(0.223)
Cognitive Test	-0.015	-0.021	0.009	0.013
	(0.016)	(0.017)	(0.034)	(0.035)
Pr. Living to 85	-0.559	-0.437	0.439	0.410
	(0.355)	(0.353)	(0.765)	(0.774)
No Insurance	-0.048	-0.066	-0.122	-0.129
	(0.277)	(0.277)	(0.331)	(0.333)
Private Insurance	0.099	0.118	-0.065	-0.069
	(0.177)	(0.175)	(0.213)	(0.214)
Net Wealth	-0.039**	-0.039**	0.027	0.028
	(0.016)	(0.016)	(0.041)	(0.042)
PIA	0.099	0.087	-0.301	-0.299
	(0.167)	(0.168)	(0.303)	(0.305)
Private Pension	0.001	0.001	0.162	0.157
	(0.002)	(0.002)	(0.184)	(0.185)
Dur0-3	0.290**	0.296**	0.369*	0.369*
	(0.127)	(0.128)	(0.202)	(0.203)
Dur3-6	-0.144**	-0.158**	-0.133	-0.131
	(0.070)	(0.070)	(0.125)	(0.125)
Dur6-12	0.055*	0.044	-0.046	-0.044
	(0.030)	(0.030)	(0.069)	(0.069)
Dur12-36	-0.024**	-0.009		
	(0.010)	(0.011)		
Dur36+ (Dur12+ in Re-Exit)	1.057***	1.260***	-0.031	-0.030
	(0.177)	(0.181)	(0.044)	(0.044)
Constant	-1.820***	-1.961***	-3.486***	-3.569***
	(0.480)	(0.477)	(0.936)	(0.941)
Log Likelihood	-2,612.242	-2,573.729	-639.271	-638.852
Sample Size	24,097	24,097	3,106	3,106

Notes: The dependent variable in the 'Exit' hazard model is the time-to-exit after age 62. The dependent variable in the 'Re-Exit' hazard model is time-to-exit after reentering the labor force after age 62. The estimates indicate the direction and magnitude of a proportional shift of the hazard, i.e. a positive sign indicates that exit is more likely (= time-to-exit from labor force is shorter). All models also control for regional dummies and year dummies for the 62^{nd} birthday. The models also include controls for missing observations on marital status, health, primary respondent, cognitive score, probability of living to 85, health insurance, net wealth, PIA, and private pension. Robust standard errors are presented in parenthesis. Data are based on the most recent available survey in each month.

Table 5: Simultaneous Model of Labor Force Exit and Benefit Claiming

	Model 1		*Model 2*	
Variable Name	**Exit Hazard**	**Claiming Hazard**	**Exit Hazard**	**Claiming Hazard**
Month Claimed	0.262		0.246	
	(0.231)		(0.269)	
Time since Claiming	**-0.243*****		**-0.240*****	
	(0.048)		(0.045)	
Time since Claiming Squared	**0.006*****		**0.006*****	
	(0.001)		(0.001)	
Not Claimed Yet	-2.346***		-2.408***	
	(0.362)		(0.228)	
Not Exited Yet		-1.216***		-1.194***
		(0.233)		(0.263)
Male	-0.087	-0.293*	-0.092	-0.303*
	(0.132)	(0.164)	(0.139)	(0.157)
White	-0.110	0.134	-0.118	0.109
	(0.151)	(0.201)	(0.139)	(0.175)
BA	-0.193	-0.260	-0.201	-0.270
	(0.161)	(0.205)	(0.162)	(0.181)
Prof. Degree	-0.020	0.061	-0.051	0.031
	(0.245)	(0.334)	(0.245)	(0.273)
Married	0.016	0.304	0.021	0.326*
	(0.165)	(0.193)	(0.169)	(0.188)
Respondent 1	-0.609***	0.155	-0.610***	0.221
	(0.140)	(0.177)	(0.128)	(0.156)
Cognitive Test	-0.028	-0.049*	-0.024	-0.043
	(0.023)	(0.027)	(0.022)	(0.026)
Pr. Living to 85	-0.642	0.007	-0.758*	-0.108
	(0.476)	(0.385)	(0.434)	(0.361)
Health Limitation for Work	0.700***	0.306	0.646***	0.260
	(0.184)	(0.224)	(0.170)	(0.205)
No Insurance	-0.025	0.440	-0.053	0.441
	(0.319)	(0.410)	(0.360)	(0.376)
Private Insurance	0.122	0.324	0.113	0.308
	(0.243)	(0.289)	(0.228)	(0.263)
Net Wealth	-0.052***	-0.050***	-0.054***	-0.050***
	(0.014)	(0.015)	(0.020)	(0.017)
PIA	0.186	0.258	0.259	0.338
	(0.205)	(0.293)	(0.216)	(0.262)
Private Pension	0.002	0.000	0.002	0.000
	(0.002)	(0.003)	(0.002)	(0.004)
Months Worked Before 62			-2.111***	-1.673***
			(0.361)	(0.521)
Dur0-3	0.402***	0.561***	0.418***	0.583***
	(0.082)	(0.088)	(0.140)	(0.088)
Dur3-6	-0.107	-0.725***	-0.104	-0.724***
	(0.067)	(0.099)	(0.075)	(0.083)
Dur6-12	0.089***	0.155***	0.089***	0.155***
	(0.029)	(0.054)	(0.032)	(0.047)
Dur12-36	-0.002	0.045***	-0.003	0.044***
	(0.011)	(0.017)	(0.011)	(0.016)
Dur36+	1.261***	4.448***	1.250***	4.458***
	(0.200)	(0.555)	(0.193)	(0.577)
Constant	-2.541***	-3.766***	-0.440	-2.235***
	(0.719)	(0.703)	(0.697)	(0.819)
Correlation Coefficient		0.969**		0.863**
		(0.458)		(0.376)
Log Likelihood		-4,151.437		-4,131.405

Notes: The dependent variable in the 'Exit Hazard' equation is the time-to-exit after age 62. The dependent variable in the 'Claiming Hazard' equation is time-to-claiming Social Security Benefits after age 62. The estimates indicate the direction and magnitude of a proportional shift of the hazard, i.e. a positive sign indicates that exit or claiming are more likely. Model 2 includes a measure of the months spent working in the year before turning 62. All models also include controls for missing observations on marital status, health, primary respondent, cognitive score, probability of living to 85, health insurance, net wealth, PIA, and private pension. Robust standard errors are presented in parenthesis. The variances of the error terms are set to 1 (i.e. $\sigma_{\varepsilon_E} = \sigma_{\varepsilon_C} = 1$) as explained in the text. Data are based on the most recent available survey in each month. Sample size is 24,097 person-months in both models.