ESSAYS IN UNITED STATES SOCIAL SECURITY POLICY

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My dissertation examines the effects that US Social Security policy changes have on labor supply and application behavior. In my first chapter, I use survey data matched to administrative records to measure the effect of a natural experiment in the provision of information - the introduction of the Social Security Statement - on Social Security Disability Insurance (DI) application behavior. I find that receipt of the Statement, a document gradually introduced in the 1990s which contained personalized information on all Social Security benefits, had a positive, substantial, and statistically significant effect on DI application, amounting to a 62% increase over the base rate. The overall effect was entirely driven by individuals reporting a work-limiting condition who were previously not employed. Furthermore, my analysis shows no evidence of applicants "shifting forward" their DI application. In the absence of these new applicants, the 32% growth rate of the per-capita DI rolls from 1995-2004 would have been approximately 25%, a 20% drop. My second chapter examines the impact of the Statement on individuals approaching retirement who are still working. I find that the effects are mixed: individuals working few hours per week prior to Statement receipt markedly increase their hours worked, while those working full time or more decrease their hours. However, it appears that individuals misunderstood that the Statement provided a retirement benefit *projection* based on constant earnings going forward. After second Statement receipt, those who previously decreased their labor supply then increased it. My third

chapter uses program interactions between the two federal disability programs - DI and Supplemental Security Income - to estimate labor supply elasticities of DI beneficiaries. Given wide variation in SSI state supplements temporally and geographically and temporal variation in DI parameters, otherwise similar DI beneficiaries may face a 50% or 0% disability benefit reduction rate. This variation in marginal rate allows for a direct calculation of labor supply responsiveness to such a rate change. My elasticity estimates - the first for US disability beneficiaries based on differences in benefit reduction rates - are inelastic and low, ranging from -0.14 to -0.36 for the participation elasticity.

BIOGRAPHICAL SKETCH

Philip Armour's primary research interests are in disability, retirement, trends in income inequality, and the intersections of behavioral economics with public policy. As an undergraduate at Pomona College, he earned a triple major in Economics, Mathematics, and English Literature, writing theses on the allocation of political power in the European Monetary Union and the changing attitude toward women in the many iterations of the story of Troilus and Cressida, examining retellings from the 12th to the 20th centuries. After graduating from Pomona, he worked on tax, education, and retirement policy at the Federal Reserve Bank of San Francisco. He went on to receive his Master's in Econometrics and Mathematical Economics from the London School of Economics, where he was also a research assistant for an ongoing project analyzing the roles that social enterprises play in the European economy. While at Cornell, he worked as a Summer Associate for the Congressional Budget Office, helping to assemble their Social Security Budget Options document, as well as researching the changing ways that households mix employment and food stamp receipt. He will be starting as an associate economist at the RAND Corporation in Santa Monica, California this summer, where he will reside with his veterinarian wife and their German Shepherd, Nala.

To my wife Andrea, the real Dr. Armour, who put up with me even at my most insufferable while I was writing this dissertation, and to my parents for their years of support and love that made everything possible.

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those of the authors and do not represent the policy of the Department of Education. The author retains sole responsibility for any errors or omissions.

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The first and second chapter of this dissertation used the Health and Retirement Study, Respondent Cross-Year Summary and Detailed Earnings, and Respondent Cross-Year Benefits restricted use datasets. Produced by the University of Michigan with funding from the National Institute on Aging (grant number NIA U01AG009740). Ann Arbor, MI (2012) and distributed to authorized users only.

The analysis included in the third chapter of this dissertation was first performed using the SIPP Synthetic Beta (SSB) on the Synthetic Data Server housed at Cornell University which is funded by NSF Grant #SES-1042181. These data are public use and may be accessed by researchers outside secure Census facilities. For more information, visit www.census.gov/sipp/synth_data.html. Final results for this paper were obtained from a validation analysis conducted by Census Bureau staff using the SIPP Completed Gold Standard Files and the programs written by this author and originally run on the SSB. The validation analysis does not imply endorsement by the Census Bureau of any methods, results, opinions, or views presented in this paper.

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CHAPTER 1

THE ROLE OF INFORMATION IN DISABILITY INSURANCE APPLICATION: AN ANALYSIS OF THE SOCIAL SECURITY STATEMENT PHASE-IN

1.1 Introduction

A recent and growing body of research documents that lack of knowledge about social programs, taxes, and savings options can result in individuals leaving a substantial amount of money on the table (Bettinger et al. 2009). Information is at the core of economic decision-making; however, many policies of both businesses and governments assign secondary importance to information provision. The general conclusion of the existing research is that timely and relevant information can be a highly cost-effective way to increase take-up among a target population (Duflo et al. 2006, Bhargava and Manoli 2011, Chetty et al. 2012). This information often has heterogeneous effects, allowing subpopulations to "catch-up" to those groups already participating at high levels (Chetty and Saez 2009, Chetty et al. 2012, Hoxby and Turner 2012, Liebman and Luttmer forthcoming).

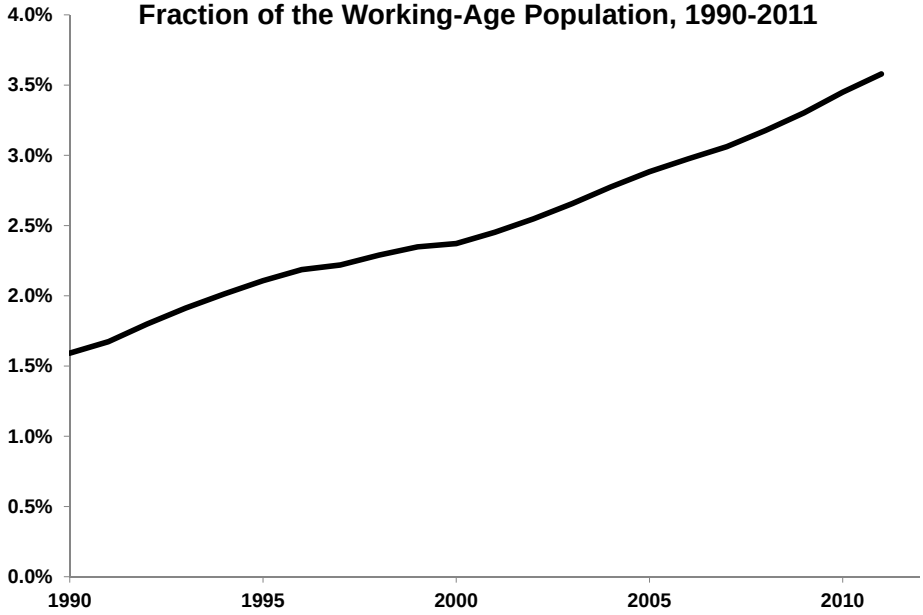
This paper, to my knowledge, is the first to look at a natural experiment in information provision with regard to Social Security Disability Insurance (DI) decision-making: the introduction of the Social Security Statement. This document provided information on the suite of Social Security benefits, including DI coverage status and potential DI benefit. Starting in 2000, the Statement was mailed annually to all workers 25 and older, with over 149 million Statements sent out in 2008, representing a massive information intervention. I exploit the

gradual introduction of the Statement in the mid-1990s to estimate how DI application decisions change after Statement receipt. I find that people react very strongly to the Statement, increasing their application rate by 62% over the base rate, and this increase is driven entirely by those not employed and reporting a work-limiting condition. These results indicate that information about personalized program benefits can substantially affect the decisions of those considering DI application, affecting both the targeting of DI and the size of the program itself.

Social Security Disability Insurance (DI), the largest income replacement program for working-age adults in the US, faces impending insolvency. The Social Security Board of Trustees projects that under current policy, the DI trust fund will be unable to cover its obligations by 2016. One of the factors in this insolvency is that the DI program, which accounts for over 15% of total payments of the Old Age, Survivor's, and Disability Insurance (OASDI) program and covers over 8 million beneficiaries, has experienced a marked rise in its rolls in the past few decades. The number of individuals receiving DI as a percentage of the working age population was 2.3% in 1980. In 2011, this fraction was 4.7% (Daly et al. 2013). Much of this growth occurred during the 1990s, as shown in per-capita terms in Figure 1.1, with the rise in these rolls as a fraction of working-age adults increasing over 50% between 1995 and 2008.

Chief among the explanations for this increase are demographic and policy changes: the aging of the population, increasing labor force participation among women leading to greater DI eligibility rates, and the increase in the Social Security retirement age. However, these explanations together explain only about 50% to 60% of the growth in the per-capita DI rolls (Daly et al. 2013, Duggan

Figure 1.1: Growth in DI Disabled Worker Rolls as a Fraction of the Working-Age Population, 1990-2011



Source: FRED Series USAWFPNA and Social Security Administration Annual Statistical Supplement 2013

and Imberman 2009). Explanations for the remaining growth are numerous, albeit smaller in impact: the additional costs of hiring and continuing to employ disabled individuals imposed on employers by the American with Disabilities Act in 1990, the welfare reform of the mid-1990s that shifted some individuals from Aid to Families with Dependent Children to DI, easing of eligibility standards and increasing use of vocational factors in disability determination, and a combination of structural changes in the labor market that negatively impact low-skill workers and increased the generosity of the DI program for lower wage workers (Stapleton and Burkhauser 2003, Autor and Duggan 2003, Duggan and Imberman 2009). Depending on the particular estimates one takes from these studies, there remains a small to a substantial unexplained portion of the recent increase in DI rolls.

No previous work has examined the role of the Social Security Statement, and the massive provision of information to the DI-covered population starting in the mid-1990s it represents, in the rise of the DI rolls. This Statement was sent out to specific age groups in different years. The first age group to receive a Statement was all workers 60 and older in 1995. Younger and younger age groups were then sent Statements from 1996 to 1999, until from 2000 onward it was sent to all individuals over the age of 25 (see Figure 1.2 for the timing of the Statement's provision). Contained in the Statement was personalized information about Social Security benefits: projected retirement benefits given a constant earnings rate, Disability Insurance coverage status and, if covered, corresponding benefit upon immediate application, and survivor's benefits for one's family (see the Appendix for an example Statement). Therefore, this Statement represents a near-universal provision to eligible individuals of otherwise difficult-to-obtain personalized information about DI benefits that is of immediate relevance to workers.

Research on the application decisions of individuals with work-limiting conditions shows that many are on the margin of DI application and may be affected by information. For example, most individuals wait a significant period of time after experiencing disability onset and applying for a disability program. The mean application delay between initial onset and DI application for men is 4 years (Burkhauser et al. 2004). Previous work on variation in the generosity of DI, access to health insurance, and interactions with other programs demonstrate (Autor and Duggan 2003, Rutledge 2012, Maestas et al. 2014) the existence of a substantial group of "conditional applicants," who have a qualifying medical disability but apply for DI only under certain conditions. Although no previous work has examined whether information can influence these "con-

Figure 1.2: Social Security Statement Phase-In Schedule

	SSA Fiscal Year							
	1994	1995	1996	1997	1998	1999	2000	2001
61 and Older		X					X	X
60		X	X	X	X	X	X	X
58-59			X				X	X
53-58				X			X	X
47-53					X		X	X
40-47						X	X	X
25-40							X	X
Total Statements Sent (millions)	0	7	5.5	12.4	20.7	26.6	134.7	135.6

Note: SSA Fiscal Years are October of the preceding calendar year to September of the stated year. No Statements were sent out before Fiscal Year 1995, and all individuals with Social Security Numbers age 25 and over received a Statement from 2000 to 2011.

ditional applicants," work on the take-up of other social programs has shown the important role of information in the likelihood of application (Meyers and Heintze 1999, Currie 2004, Chetty et al. 2012).

Using the Health and Retirement Study panels matched to Social Security Administration earnings and beneficiary records, I estimate the impact of Statement receipt on DI application rates for an individual in a given year. Because the Statement was phased-in according to age group, with different cohorts receiving Statements in different years, I control for unobservable trends in DI application by comparing the behavior of adjacent, otherwise identical, cohorts. I find that the Intent-to-Treat of the Statement has a statistically significant and substantial effect on the likelihood of DI application among older workers, amounting to an increase of about 1.3 percentage points per two-year period

in the general DI-covered population, representing an approximately 62% increase.

When the effect is decomposed by health condition, it becomes clear that the overall estimated increase masks heterogeneity. There is a small but statistically insignificant decrease in DI application among the general population after Statement receipt, but those individuals with self-reported work-limiting conditions increased their marginal likelihood to apply for DI by 11 percentage points, more than double their base rate. When further decomposed, this large effect is entirely due to work-limited individuals who were previously not working. Additionally, there is no decrease in the average rate of acceptance of applicants onto the rolls, nor is there evidence that this increase in applicants is due to individuals who would eventually apply for DI "shifting forward" their DI application decision. Although the Statement's effect attenuates with older individuals, it is still positive and significant, and the effect does not become negative as time after Statement receipt passes, both of which indicate that the overall propensity to apply for DI has risen post-Statement.

Because these are new applicants, a portion of the rise in the DI rolls during the period of this analysis (1992-2004) can be attributed to the provision of the Statement. Reducing the actual DI awards by age group from 1995 to 2004 by the estimated number of applicants induced to enter due to Statement receipt (or more specifically, the fraction of these induced applicants who are accepted onto the rolls), I find that the 32% rise in the per-capita DI rolls from 1995 to 2004 would have been 7 percentage points lower. That is, about 20% of the increase over this period can be explained by the provision of the Social Security Statement.

The significant application and entrance effects point to the importance of informational costs in DI, suggesting that information provision is an important policy lever among the population covered by DI.[1] This paper contributes to the growing field that analyzes the salient factors in the DI application decision (Stapleton and Burkhauser 2003, Autor and Duggan 2003), as well as the more general role of information in social program application and take-up (Currie 2004, Bettinger et al. 2009, Chetty et al. 2012). By demonstrating the import of this information in increasing DI rolls so markedly, this paper provides a new explanation for part of the large rise in the DI rolls observed in recent decades.

The rest of the paper proceeds as follows: Section 2 discusses the relevant features of Disability Insurance; Section 3 describes the structure of the Social Security Statement's phase-in; Section 4 describes the HRS-SSA matched data; Section 5 presents the empirical methodology; Section 6 presents the results; Section 7 estimates the implied effect on the growth in DI rolls; while Section 8 concludes. An example Statement is available in the Appendix.

1.2 Disability Insurance

Social Security Disability Insurance is the largest disability program in the US. It is part of the Old Age, Survivors, and Disability Insurance social insurance, commonly known as Social Security. However, instead of providing retirement income, it insures workers' earnings in the event of the onset of a work-limiting condition. This condition must reduce earnings potential under a Substantial

[1] As of 2012, the Social Security Administration is no longer automatically sending out a personalized Statement to every American over 25 due to budgetary considerations; however, they are still available upon request. Furthermore, a recent Social Security Advisory Board position paper has argued for the reintroduction of automatic Statement provision.

Gainful Activity level, as well as be expected to last at least 12 months or result in death.

Benefit determination for DI follows many of the same rules as Social Security Old Age Insurance (OAI) benefits. However, to qualify for DI benefits, a potential beneficiary must be both medically eligible and satisfy DI's recent-work requirement, and because DI is designed for working-age adults, the coverage requirements and benefit determination differ depending on age. For example, while retirement benefits are based on the 35 years of highest indexed earnings, DI benefits are based on between 2 and 35 years of indexed earnings, depending on age at time of application. Since the parameters for DI coverage and benefits are based on age in addition to the earnings and overall wage growth factors used in the calculation of retirement benefits, an individual faces signficant informational costs in determining his or her coverage status and potential benefit.

The medical eligibility is based on both the nature and severity of the impairment, as well as earnings capacity. If applicants' conditions are not in the Listings of Impairments, then their work capacity is evaluated. In order to be eligible, they must be unable to earn above a Substantial Gainful Activity level, at $1,040 per month for non-blind individuals in 2013. See Burkhauser and Daly (2011) for a full description of this process.

The second requirement for DI entry, the recent-work requirement, is age dependent. For example, a 20-year-old applicant must have earned 6 Quarters of Coverage in the most recent 3 years (12 quarters), while a 50-year-old applicant needs to have earned 20 Quarters of Coverage (QCs) in the most recent 10 years (40 quarters). In 2013, a QC was allocated for each whole multiple of $1,160 of

earnings, with up to 4 QCs earned per year. The historical income levels that define a Quarter of Coverage and the schedule describing the requirement at different ages are available in the Social Security Administration Annual Statistical Supplement;[2] it suffices to note that since the income requirement for QCs changes with the National Average Wage Index and the age of the applicant, the complexities of DI coverage represent a significant knowledge barrier. For the remainder of the paper, I refer to this eligibility requirement as DI coverage to distinguish it from medical eligibility, a condition I cannot fully observe, although for which self-reporting of a work-limiting condition has been shown to be an unbiased proxy (Benitez-Silva et al. 2004a).

Since DI is a social insurance program, a potential program participant's benefit level is dependent on previous earnings, related to how much they have paid into the program. Disability Insurance follows the same calculation process as Old Age Insurance, first determining an Average Indexed Monthly Earnings (AIME) based on a given number of computation years, which is then translated into a monthly benefit through the progressive Primary Insurance Amount (PIA) schedule.[3] However, of particular note is that the number of computation years - years of earnings that are indexed to wage growth and then averaged to determine the AIME - varies depending on the age of the applicant. As stated above, the number of computation years can be as low as 2 and as high as 35, again adding a layer of computational complexity on top of the already complex OAI benefit calculation process.[4]

[2] Available at http://www.ssa.gov/policy/docs/statcomps/supplement/

[3] The exact structure of the AIME and PIA computation process is also available in the Annual Statistical Supplement.

[4] The DI benefit calculation formula at the Normal Retirement Age corresponds to the Old Age Insurance formula. Therefore, at this age, individuals on DI are transferred from DI to OASI automatically and continue to receive the same benefit, while any potential DI applicants instead face the choice of when to collect their retirement benefits.

Mastrobuoni (2011) reviews older Americans' inaccurate knowledge of their own OAI benefits, finding that older Americans have a poor understanding of their OAI benefits, although this knowledge improves as a worker nears retirement. Since DI's benefit and eligibility structures have additional layers of complexity, knowledge of coverage and benefit level is most likely even lower. Although one's DI coverage status and potential benefit can be learned by either visiting a SSA office during business hours and requesting this information or by visiting SSA's website and using their benefit calculator, the former represents a definite transaction cost while the latter was unavailable over the time period studied here, and even now, requires the input of one's previous earnings in every calendar year. Therefore, the automatic and yearly distribution of a document showing DI coverage and potential benefit represents a dramatic reduction in the cost of acquiring this information. Since informational costs have previously been shown to be relevant in depressing take-up of other social programs (Meyers and Heintze 1999, Bhargava and Manoli 2011), distribution of previously difficult to acquire DI information, presented in a clear context, may be expected to change DI application behavior if lack of information is an important factor.

Information also may play a role in the sorting of which individuals choose to apply. DI eligibility depends on two components: first, sufficient recent earnings to qualify for DI coverage, and second, a medically qualifying disability. Ascertaining the presence of the latter is an unavoidable noisy process administered by the Social Security Administration and state-level gatekeepers (see Maestas et al. (2013) for a review of the determination process). A long-standing literature in DI research has shown that this disability screening process results in both acceptance of work-capable individuals and rejection of medically el-

igible individuals. Much research has concentrated on the prevalence of the former problem - accepting applicants who do not have a qualifying disability - and found that between 15% and 50% of those accepted onto the rolls would work if not receiving DI benefits, depending on disability type (Bound 1989, Maestas et al. 2013). However, (Benitez-Silva et al., 2004b) show that although approximately 20% of applicants accepted onto the rolls do not meet the statutory disability requirements, 60% of applicants rejected do meet these requirements. Many of the stages of determination currently have long backlogs. If self-sorting can become more efficient on the DI application margin, then these backlogs and overall wait times for eligible individuals can decrease.

As discussed above, the DI rolls have increased markedly both in absolute terms and as a fraction of the working-age population. Explanations abound for this increase, with demographic and program shifts accounting for a majority of the increase. There is still discussion as to what describes the remaining portion, be it increasing program generosity for low-wage workers, employer disincentives to hire individuals with disabilities perversly created by the American with Disabilities Act, or liberalization of the disability determination process. However, there remains unexplained growth in these rolls, as well as a current surfeit of papers illustrating that there are many more individuals on the margin of DI application than just those who have recently experienced a serious health shock.

The above research demonstrates that there are many medically-eligible individuals on the margin of DI application, and changes in program generosity, employment situation, and other social programs influence their application decision. Moreover, many individuals exit the labor force for an extended period

of time to apply for DI, despite being eventually deemed ineligible for benefit receipt. A previously unstudied factor that can affect both these facets of DI application behavior is information about the program itself.

1.3 The Social Security Statement

Starting in 1990, the Social Security Administration began providing benefit statements for all individuals who requested them, and starting in late 1994, Statements were *automatically* sent out. These Social Security Statements eventually were automatically sent annually to all Americans 25 and older between 2000 and 2011 and contained personalized information about OASDI benefits upon retirement, disability, or death. The Appendix contains a fictional example Statement provided by SSA. In addition to providing information on these benefits, the Statement also displays each worker's historical covered earnings, allowing for a Statement recipient to check whether SSA has a correct record of his or her earnings history. Although previous research on the Statement finds a lack of any compelling effect of this information on retirement behavior and limited impact on OAI benefit knowledge (Mastrobuoni 2007, Biggs 2010, Mastrobuoni 2011), the Statement is much more informative with regard to DI decision-making, as will be discussed below, thus can be expected to have larger impact on behavior.

Although the Statement has, until recently, been sent to those 25 and older, it was phased in across different age groups in the late 1990s. The Statement was initially sent out to those age 60 and over in 1995, as well as all those turning 60 from 1995 onward. Additionally, in 1996, they were automatically sent to those

58 to 60; in 1997, 53 to 58; in 1998, 47 to 53; in 1999, 40 to 47; and in 2000, 25 and over.[5] Figure 1.2 illustrates which age groups received the Statement in which Fiscal Year, as well as the total number of Statements sent out. This phase-in schedule provides a natural experiment in the provision of information about OASDI benefits in the late 1990s. Previous research on this Statement has shown that once one controls for age and year, no other factors influence Statement receipt (Mastrobuoni 2011).

The Statement describes retirement benefits, based on an earnings level consistent with that of the past two years, if a retiree elects to receive benefits at the Early Retirement Age (62), the Full Retirement Age (between 66 and 67, depending on birth cohort), and age 70. It also states whether an individual's work experience provides coverage for Disability Insurance benefits, and if so, what those benefits would be each month. The only previous research on the effect of the Statement on Social Security behavior found no average change in timing of collecting Old Age Insurance, nor any change in the responsiveness of older Americans to the effect of additional earnings on these retirement benefits (Mastrobuoni 2011).

Since retirement benefits are temporally removed from current decision-making and may change considerably between the time of receipt (especially with younger individuals) and the decision to begin receiving retirement benefits, it is *a priori* unclear that a rational agent *should* react to this information. This information is a snapshot of what these benefits might be at particular points in the future but provides no information on how changes in earnings between

[5]The years described here correspond to SSA fiscal years, which start in October. The exact timing of Statement receipt depends on one's birth month, but approximately one third of those 60 and over received a Statement in 1994: those born October, November, or December 1994, or January 1995.

now and these future dates affect benefits. The DI benefit level in the Statement, on the other hand, is the benefit available to individuals *right now*,[6] which is of immediate relevance to a different target population. Although the previous research found no impact on retirement timing, the impact on DI behavior is a distinct and largely unrelated empirical question, which this paper addresses directly.

1.4 Data

1.4.1 Data Description

This paper uses the Health and Retirement Study panels, matched to Social Security earnings and benefits records. The HRS is a national panel survey of individuals over age 50 and their spouses. The survey elicits information about demographics, income, assets, health, cognition, job status and history, expectations, and insurance and is administered by the Institute for Social Research (ISR) at the University of Michigan. It consists of six cohorts:

1. The Initial HRS cohort, born between 1931 and 1941, first interviewed in 1992 and reinterviewed every 2 years;
2. AHEAD cohort, born before 1924, initially the separate Study of Assets and Health Dynamics Among the Oldest Old, first interviewed in 1993, then in 1995, 1998, and subsequently every two years;

[6] Although the example Statement in the Appendix shows the DI benefit of someone covered by DI, if one is not covered, then it simply states this lack of coverage, without displaying any potential benefit information.

3. Children of Depression (CODA) cohort, born 1924 to 1930, first interviewed in 1998 and subsequently every two years;
4. War Baby (WB) cohort, born 1942 to 1947, first interviewed in 1998 and subsequently every two years;
5. Early Baby Boomer (EBB) cohort, born 1948 to 1953, first interviewed in 2004;
6. Mid Baby Boomer (MBB) cohort, born 1954-1959, first interviewed in 2010.

For this analysis, I primarily use the initial cohort, as well as the AHEAD, CODA, and WB cohorts, since the fifth and sixth cohorts enter after the Statement has been universally provided, and the last year I use in my sample is 2004. These panels are then matched to Social Security Respondent Cross-Year Summary Earnings, for which the match rate is approximately 72% among the cohorts I use, and 66% overall for the Initial Cohort (Mitchell et al., 1996). These records provide earnings from 1951 to the year of the match. The match is imperfect due to two factors: approximately a quarter of respondents do not grant permission to have their administrative records matched, while the remaining unmatched individuals provided erroneous Social Security Numbers. Previous research using these matched data show that for the Initial Cohort, the matched subset is an unbiased subsample (Kapteyn et al. 2006, Michaud and Van Soest 2008). These earnings records include earnings histories only up to the year of the match, corresponding to when a given individual enters the HRS panels, after which I have only self-reported earnings. Additionally, individuals who had their SSA records matched previously and were still in the panel in 2004 had their earnings and benefits records updated with information from the intervening years.

Additionally, I use self-reported DI application dates from the RAND HRS file, since for much of my sample, administrative data has not been re-matched.[7] For those for whom it has, the correlation between the two is above 0.8. Therefore, these records provide historical earnings but are not updated for every individual. The match to the administrative earnings records allows for the use of historical earnings and Quarters of Coverage, as well as statutory rules on the number of calculation years and QCs required by age, to assign DI coverage status and DI PIA in either 1994 - before anyone received a Statement - or in the last year of their match, whichever was earlier.[8] This information allows for a reconstruction of the information appearing on each individual's first Statement. These variables were calculated before Statement receipt to avoid any possible behavioral responses of Statement receipt on DI coverage and PIA, since these values change depending on individual labor supply which the Statement can influence. Disability Insurance coverage status and potential benefit are thus constant for all within-person years.

Where possible, I use the RAND HRS file, a cleaned and standardized version of the public-use HRS available publicly on the HRS website, for any HRS panel question. The HRS asks individuals a range of questions relating to disabilities. Specifically, in every wave, individuals are asked whether they have a condition that limits work, as well as extensive questions on conditions that may affect Activities of Daily Life, Instrumental Activities of Daily Life, the score on

[7] Although before wave 5 of the HRS (year 2000), there is not separate identification of application for SSI, the other federal disability program, or DI, I limit my analysis to individuals who are fully insured by SSDI. SSI applicants are also required to apply for any other benefits they may be eligible for, including SSDI. Limiting one's analysis to SSDI-insured individuals has previously been used for isolating DI applicants in these earlier waves in the HRS for the purpose of DI application (Li and Maestas 2008).

[8] For example, a member of the 1992 cohort who is not SSA rematched in 2004 has coverage status based on their 1992 earnings while a 1992 cohort rematched in 2004 has a coverage status based on earnings through 1994. The analysis presented below is robust to alterations in this procedure.

the Center for Epidemiologic Studies Depression (CESD) scale, and back problems. Each individual is asked if he or she has applied for DI, and if so, in what year and month. These responses are used to determine whether an individual has applied for DI since their last interview.[9]

For the purpose of this paper, the unit of analysis is the person-year, following the Allison (1984) survival framework. For each individual, there is a separate observation for every interview date they were "at risk" of applying for DI from 1992-2004, i.e. if they are alive, over 50 but under the Full Retirement Age,[10] have worked enough to obtain "Fully Insured" status, and have not previously applied for DI or SSI. Individuals contribute an observation up until and including the year in which they apply for DI or SSI.[11] The binary dependent variable, DI application, is then assigned the value 1, and individuals contribute no further observations, since they are no longer at risk of applying for DI. Table 1.1 shows the results of the above sample restrictions, with a final count of 40,308 person-years, corresponding to 12,113 unique persons. Additionally, in Table 1.12, I analyze DI entrance. The analytic structure and sample are identical in this part of the analysis, with the exception of the dependent variable. For DI entrance, the dependent variable is 1 only if the person applied for DI since the last interview *and was eventually accepted onto the rolls* and is zero otherwise.

[9] Although application dates are available through the Respondent Cross-Year Benefits file, the records in this file have the same limitation as the earnings records: they only provide records up until an individual enters the HRS panel or if they stay in the panel until 2004.

[10] Because data on under-50 spouses of respondents are irregular, they are omitted from this analysis. However, inclusion of these spouses does not change any of the results for other age groups, and they appear largely unaffected by Statement receipt, although estimation of their behavior is underpowered in this paper's analytic framework. Moreover, these individuals are outside of the sampling frame of the HRS, and thus their reactions cannot be interpreted as representative of their segment of the population, i.e. they have zero weights in the HRS.

[11] Since SSI receipt requires individuals to apply for all other available programs for which they may be eligible, individuals are no longer at risk of applying for DI after they have applied for SSI: they have, in essence, applied for both.

Table 1.1

Sample Construction

Sample selection restriction	Remaining Person-years
Non-missing application data	62,948
Alive	62,267
Have not previously applied to DI/SSI	54,758
SSDI Fully Insured and between 50 and 64	40,308
Unique Persons	12,113

Statement receipt is defined as ever having received a Statement before the current interview date. As soon as an individual receives a Statement, as calculated using the rollout depicted in Figure 1.2 and in accordance with Mastrobuoni (2011)'s monthly-receipt schedule based on birth month and year, the Statement receipt variable is 1 until they leave the sample. Since I have information on month and year of birth, interview month and year, and DI application month and year, I can determine if an individual has received a Statement prior to an interview.[12] However, if an individual both applies for DI and receives

[12]In the analysis below, I use variation between cohorts in Statement receipt to estimate an information effect on DI behavior. It is possible to use intra-cohort variation, measuring the difference in DI application between two individuals born in the same year, but only one of whom has received a Statement when he is interviewed. This source of variation would only measure the immediate impact of information on DI application; my multiple-Statement analysis suggests that the Statement's effect is delayed by at least one year. Moreover, given the biennial nature of the HRS, this estimation technique would be substantially underpowered; however, I will use this intra-cohort technique to test the impact of Statement receipt on self-reporting

a Statement since his last interview, but he applied for DI first, the Statement receipt variable is 0.

Additionally, DI PIA quintile is calculated as the quintile of an individual's DI potential benefit in the distribution of DI benefits in the year of its calculation: either when the individual enters the HRS panel or 1994, whichever is earlier.

Table 1.2 provides summary statistics of these main variables and control variables used in this analysis, with the person-year as the unit of analysis, for the entire sample used, the subsample that has not received a Statement, and the subsample self-identifying a work-limiting condition.

1.5 Methodology

The primary question I address in this paper is whether showing individuals' their DI coverage status and potential DI benefit affects their likelihood of applying for this program. These reactions have strong implications for the DI program and individuals' income: application to DI generally requires exit from the labor force, while exits from DI to the labor force are rare, and even in the event of denial, there is evidence of human capital decay during the lengthy DI application and determination process (Autor et al. 2011).

However, in as much as added information allows potential applicants to sort themselves along the DI application margin, if those who are more likely to be accepted onto the rolls are induced to apply while those who are less likely instead opt not to apply, this information provision can increase the coverage of

of health conditions, to determine if being informed of DI's existence and one's benefit makes one's health conditions more salient.

Table 1.2

Descriptive Statistics

Full Sample

	Mean	SD
Has Received a Statement	58.5%	49.3%
Male	47.5%	49.9%
Years of Education	13.11	2.79
Initial Earnings	27174.14	42819.62
Initial PIA	870.68	292.83
Applied for Disability	2.8%	15.0%
Accepted onto Disability	2.2%	13.4%
Age	57.02	3.74
Any Work-Limiting Condition	12.8%	33.4%

Subsample with No Statement Receipt

	Mean	SD
Has Received a Statement	0	0
Male	47.9%	50.0%
Years of Education	12.85	2.85
Initial Earnings	25555.46	39414.21
Initial PIA	851.85	292.57
Applied for Disability	2.1%	11.5%
Accepted onto Disability	1.6%	10.1%
Age	56.54	3.44
Any Work-Limiting Condition	12.6%	33.2%

Subsample with Work-Limiting Condition

	Mean	SD
Has Received a Statement	59.2%	49.2%
Male	49.3%	50.0%
Years of Education	12.41	2.86
Initial Earnings	17568.12	19984.21
Initial PIA	800.40	295.62
Applied for Disability	18.5%	37.1%
Accepted onto Disability	15.6%	34.3%
Age	57.28	3.82
Any Work-Limiting Condition	1	0

Source: HRS Waves 1-7

the target population.

My analysis identifies the Intent-to-Treat effect of Statement receipt on DI application, following the Allison (1984) person-year approach described above.

This analytic structure allows me to estimate the effect of Statement receipt on DI application as measured by the parameter β in the below linear-probability model:

$$DI\_application_{it} = \alpha + \beta S_{it} IS_{it} X_{it} + X_{it}\Lambda + Y_{it}\gamma + \epsilon_{it} \tag{1.1}$$

where α is a constant, β is the coefficient vector of interest, and S_{it} is ever having received a Statement. X_{it} is a set of covariates that vary by person-year, including marital status, educational level, and drop in the present value of OAI benefits due to the rising Normal Retirement Age,[13] The diagonal matrix IS_{it} changes depending on which Statement receipt interaction terms are included in the particular specification. Y_{it} is initially a set of indicators for each year and age in the my sample, thus γ corresponds to fixed-effect coefficients controlling for each age and year.[14] All regressions two-way cluster standard errors at the year and birthyear level (Cameron et al. 2011).

Because of the phase-in structure of the Statement, equation (1.1) estimates the average effect of post-Statement receipt when controlling for the above covariates, as well as age and year fixed effects. Any time trends in DI application common to all ages or time-invariant differences between age groups that otherwise affect DI application in this period will be absorbed. For example, any labor force changes that are common to all ages will be absorbed by the year fixed effects, while differences in DI application rates by age are accounted for by age fixed effects. Since the variation in the Statement is both by age and by

[13]This decline in present value is calculated using the methodology employed in (Duggan et al., 2007), since during this time period, the rise in the Normal Retirement Age increased the relative present value of DI benefits over OASI benefits. This change has been shown to affect the likelihood of DI application over this time period and is thus included to prevent conflation of this effect with Statement receipt (Duggan et al. 2007, Li and Maestas 2008).

[14]The analyses below employ a linear probability specification; however, logit analyses are consistent with these results from the linear probability regressions, both qualitatively and in the case of the overall increase in DI application, quantitatively, since logits estimate a 55% to 60% increase over the base rate.

year, β can be interpreted as a set of difference-in-difference estimates that compare changes in DI application rates across cohorts when workers of different ages receive a Statement.

However, this difference-in-difference structure means that if there are any age-specific time trends that are unrelated to Statement receipt but occur during this time period, they will bias the coefficient on the Statement receipt variable. Because of the potential for labor market changes affecting only those in particular age bins or changes in DI rules that disproportionately affect different age groups (an example of such a change would be the accounting of vocational factors in DI eligibility requirements concentrated among those above a certain age), I estimate additional specifications controlling for 5-year age-group-specific year dummy variables. These 5-year age groups are overlapping but not collinear with the Statement recipient age groups. For example, those 58-59 received a Statement in 1996, 53-58 in 1997, and 50-53 in 1998, while the age-group controls are for those age 50-54 and 55-59. The staggering between the two sets of age groups allows for identification of the effect of Statement receipt separate from age-specific year fixed effects by comparing DI application rates within age groups when one set of this age group receives a Statement. The only remaining factors that may bias the Statement receipt coefficient would be those almost exactly following the Statement phase-in schedule.[15] These age group specific year fixed effects are estimated using the following specification:

[15] In essence, I am exploiting the variation in timing of receipt between adjacent birth cohorts. For example, of those born between 1935 and 1939, the first Statement could have been received in 1995, 1996, or 1997. I then can control for separate year effects specifically for this 5-year age group which will not be collinear with Statement receipt, isolating any trends common to the 5-year age group.

$$DI\_application_{it} = \alpha + \beta S_{it} IS_{it} X_{it} + X_{it}\Lambda + (Age\_Group)_{it} Year_t \gamma + \epsilon_{it} \quad (1.2)$$

where $(Age\_Group)_{it}$ is a vector of 5-year age group dummy variables, and $Year_t$ is a vector of year-specific dummy variables. Subsequent specifications also include Statement interaction terms with work-limited status, previous employment, other disability conditions, and potential DI benefit interaction terms.

Equations (1.1) and (1.2) both contain an important assumption of the role of information on DI application decision-making - that the Statement reveals the program's existence and has a constant effect afterward. This assumption is based on Mastrobuoni (2011)'s analysis and is common to most difference-in-differences analyses, and although it allows for straightforward extrapolation of the results to trends in the DI rolls, I will relax this assumption and allow for a time-varying effect in Tables 1.10 and 1.11 of the Results Section below. Furthermore, one can conceptually separate the information effect of the Statement on DI decision-making into two components: one is the revelation that the program exists, and the second is the revelation of one's potential benefit. The former cannot decrease the likelihood of DI application in absolute terms, while the second can. I will examine these distinct effects by estimating the impact of the Statement along the distribution of DI benefits of the individuals in my sample.

Table 1.3

Effect of Statement Receipt on DI Application, by Work-Limiting Condition and Prior Knowledge , OLS Coefficient Results

	DI Application				
	(1)	(2)	(3)	(4)	(5)
Statement Receipt	0.014**	0.015**	0.013**	-0.003	-0.002
	[0.006]	[0.007]	[0.005]	[0.009]	[0.009]
Ever Asked About OASI Benefits					0.004
					[0.003]
Statement X Ever Asked					0.002
					[0.004]
Work-Limiting Condition				0.097***	0.111***
				[0.019]	[0.021]
Statement X Work-Limiting Condition				0.108***	0.112***
				[0.039]	[0.040]
Work-Limiting X Ever Asked					-0.051***
					[0.015]
Statement X Work-Limiting X Ever Asked					-0.042**
					[0.021]
Age Controls	Yes	No	No	No	No
Year Controls	Yes	No	No	No	No
5-year Age Group X Year Dummies	No	Yes	Yes	Yes	Yes
Fully Insured Only	No	No	Yes	Yes	Yes
No-Statement DI Application Mean					
General Population	0.021	0.021	0.021	0.021	0.021
Person-Years	50831	50831	40308	40308	40308
R-squared	0.025	0.025	0.017	0.151	0.167

Note: Linear probabiliy regression (weighted) using individuals 50-64 from the HRS. Person-year is the unit of analysis. Individuals followed until (inclusively) the year in which they apply for Disability Insurance or Supplemental Security Income. Dependent variable is whether applied for DI in previous two years. Statement receipt defined as ever having received a Social Security Statement (except if applied for DI before Statement receipt). Work-limiting condition is self-reported work-limitation in the previous year. "Ever Asked" variable correponds to whether respondent answered that they had at some point contacted SSA for personalized retirement benefit information. All regressions control for gender, educational attainment, and reduction in OAI benefits due to rising Normal Retirement Age. Sample limited to living, DI fully insured individuals (if indicated), age 50 to 64. Age controls are a dummy for each age. Year controls are a dummy for each year. Age Group X Year Dummies correspond to a separate dummy for each 5 year age group (50-54, 55-59, 60-64) in each year. Standard errors in brackets, two-way clustered at the year and birthyear levels.

*** p<0.01, ** p<0.05, * p<0.1

1.6 Results

Table 1.3 presents the initial results from the above methodology. Specifically, Columns 1 and 2 show the Statement coefficient estimates from the two above

specifications over the entire sample, controlling for the demographic variables and fixed effects discussed above in a linear probability framework. Column 3 goes on to restrict this analysis to the subsample that is DI covered before Statement receipt. From Column 1, which includes separate age and year dummy variables for the entire HRS sample, DI-covered or not, to Column 3, where I have separate year dummy variables for each 5-year age group and restrict my sample to those DI-covered, the overall Statement receipt coefficient falls from an increase in the two-year DI application rate of about 1.5 percentage point down to 1.3 percentage points. Given the base two-year rate of pre-Statement application of 2.1%, this marginal effect is an increase of about 62%. Since this estimate is highly statistically significant across controls and samples, there is clearly an aggregate effect of Statement provision on DI application propensity in the population at large. The remaining analysis in this paper isolates for whom and how the Statement affects DI application rates.

Column 4 shows the Statement receipt effect broken out into its impact on those with and without a self-reported work-limiting condition in the interview before the current wave. The likelihood of DI application among the work-limited population, independent of Statement receipt, is higher by 9.7 percentage points. However, the previous Statement estimate among the entire population was the average of a small and statistically insignificant, negative Statement impact on the entire sample and a large and statistically significant positive Statement impact on the work-limited sample. The Statement increases this work-limited population's DI application likelihood by about 11 percentage points. Taking into account the overall effect of the Statement on this population and its base-rate, this marginal increase amounts to a 96% rise in the likelihood of DI application. Inasmuch as self-reported work-limiting conditions proxies

for medical eligibility for DI benefits, the effect of Statement receipt shown in Table 1.3 - resulting in higher application rates among the work-limited - represents an increase in the efficiency of the self-sorting process. The applicant pool itself will have fewer misclassifications present on average, since prior work has shown that self-identification of a work-limiting condition in the HRS is an unbiased proxy for disability as defined by DI/SSI medical-disability determiners (Benitez-Silva et al. 2004a).

Since these effects are large, one may be concerned that the age-group-specific year dummies are not capturing other important policy shifts or secular trends, and the estimated Statement coefficient is conflating the Statement's effect with these non-informational trends. To address this concern, Column 5 includes interaction variables with the HRS question of whether a respondent previously asked the Social Security Administration to calculate their retirement benefits, a service first available in the early 1980s (Smith and Couch 2010). Although the question does not ask about either when SSA was contacted or about disability-related requests, DI coverage status and potential benefit level would have been included with the information requested. The coefficients from this column indicate that, indeed, prior knowledge about personalized OASDI benefits attenuates the effect of Statement receipt, thereby rejecting the hypothesis that these estimates entirely driven by non-informational trends correlated to Statement receipt.

As a further falsification test, I construct leading Statement recent variable; that is, a variable that mirrors Statement receipt but occurs one interview earlier. Because this variable is similar to the Statement's but does not actually track its release, it provides a test as to whether my Statement variable isolates

Table 1.4

Effect of Statement Receipt on DI Application, by Work-Limiting Condition and Lead Statement Receipt

	DI Application	
	(1)	(2)
Statement Receipt	0.015**	-0.0003
	[0.005]	[0.007]
Leading Statement Receipt	0.002	-0.003
	[0.002]	[0.006]
Work-Limiting Condition		0.091***
		[0.022]
Statement X Work-Limiting Condition		0.098**
		[0.042]
Leading Statement X Work-Limiting		0.031
		[0.035]
5-year Age Group X Year Dummies	Yes	Yes
Fully Insured Only	Yes	Yes
No-Statement DI Application Mean		
General Population	0.021	0.021
Person-Years	29039	29039
R-squared	0.014	0.141

Note: Linear probabiliy regression (weighted) using individuals 50-64 from the HRS. Person-year is the unit of analysis. Individuals followed until (inclusively) the year in which they apply for Disability Insurance or Supplemental Security Income. Dependent variable is whether applied for DI in previous two years. Statement receipt defined as ever having received a Social Security Statement (except if applied for DI before Statement receipt). Work-limiting condition is self-reported work-limitation in the previous year. "Ever Asked" variable correponds to whether respondent answered that they had at some point contacted SSA for personalized retirement benefit information. All regressions control for gender, educational attainment, and reduction in OAI benefits due to rising Normal Retirement Age. Sample limited to living, DI fully insured individuals (if indicated), age 50 to 64. "Leading Statement" defined as wave before first Statement receipt. Age Group X Year Dummies correspond to a separate dummy for each 5 year age group (50-54, 55-59, 60-64) in each year. Standard errors in brackets, twow-way clustered at the year and birthyear levels.

*** p<0.01, ** p<0.05, * p<0.1

the information intervention or other trends. Table 1.4 shows the results of this analysis for the general population and interacted with the work-limited population. Both specifications show that there is no effect from this placebo variable, while the Statement effect remains statistically unchanged.

Table 1.5

Effect of Statement Receipt on DI Application by Work-Limiting Condition and Recent Work Status

	DI Application	
	(1)	(2)
Statement Receipt	-0.003	-0.001
	[0.009]	[0.002]
Working (lagged)		-0.002
		[0.002]
Statement X Working (lagged)		-0.029
		[0.060]
Work-Limiting Condition	0.097***	0.108***
	[0.019]	[0.024]
Statement X Work-Limiting Condition	0.108***	0.103***
	[0.039]	[0.041]
Work-Limiting X Working (lagged)		-0.089***
		[0.026]
Statement X Work-Limiting X Working (lagged)		-0.094***
		[0.039']
5-year Age Group X Year Dummies	Yes	Yes
Fully Insured Only	Yes	Yes
No-Statement DI Application Mean		
General Population	0.021	0.021
Person-Years	40308	40308
R-squared	0.151	0.168

Note: Linear probabiliy regression (weighted) using individuals 50-64 from the HRS. Person-year is the unit of analysis. Individuals followed until (inclusively) the year in which they apply for Disability Insurance or Supplemental Security Income. Dependent variable is whether applied for DI in previous two years. Statement receipt defined as ever having received a Social Security Statement (except if applied for DI before Statement receipt). Work-limiting condition is self-reported work-limitation in the previous year. "Working" variable correponds to whether respondent answered that they were employed in the previous interview wave. All regressions control for gender, educational attainment, and reduction in OAI benefits due to rising Normal Retirement Age. Sample limited to living, DI fully insured individuals (if indicated), age 50 to 64. Age Group X Year Dummies correspond to a separate dummy for each 5 year age group (50-54, 55-59, 60-64) in each year. Standard errors in brackets, two-way clustered at the year and birthyear levels.

*** p<0.01, ** p<0.05, * p<0.1

I now turn to an examination of the heterogeneous effects of Statement receipt on subpopulations of my sample. Table 1.3 showed that the aggregate positive impact is the combination of a very large positive effect among the work-limited population and a negative effect among the general population. Table

1.5 shows this effect decomposed by work-status during the previous interview, since one's likelihood of exiting the labor force to apply for DI after receiving a Statement may be mediated by whether one is currently working. Column 1 corresponds to the last column in Table 1.3 for ease of comparison, while Column 2 further breaks the effect down by work-limiting condition, finding that the large increase in DI application likelihood of those with a work-limiting condition is isolated to those not working who identify a work-limiting condition: the target population of the DI program. Statement receipt decreases the likelihood of application of those without a work-limiting condition, indicating greater match efficiency due to Statement receipt.

Table 1.6

Effect of Statement Receipt on DI Application, by Education and Work-Limited Status

	DI Application
	(1)
High School or Less X Statement	-0.002
	[0.007]
High School or Less X WL X Statement	0.152***
	[0.040]
Any College X Statement	-0.004**
	[0.002]
Any College X WL X Statement	-0.05
	[0.038]
More than College X Statement	-0.002
	[0.002]
More than College X WL X Statement	0.015
	[0.033]
Education and Education X WL Controls	Yes
5-year Age Group X Year Dummies	Yes
Person-Years	40308
R-squared	0.163

Note: Linear probabiliy regression (weighted) using individuals 50-64 from the HRS. Person-year is the unit of analysis. Individuals followed until (inclusively) the year in which they apply for Disability Insurance or Supplemental Security Income. Dependent variable is whether applied for DI in previous two years. Statement receipt defined as ever having received a Social Security Statement (except if applied for DI before Statement receipt). All regressions control for gender, educational attainment, and reduction in OAI benefits due to rising Normal Retirement Age. Sample limited to living, DI fully insured individuals (if indicated), age 50 to 64. Age Group X Year Dummies correspond to a separate dummy for each 5 year age group (50-54, 55-59, 60-64) in each year. Standard errors in brackets, two-way clustered at year and birthyear levels.

*** p<0.01, ** p<0.05, * p<0.1

Table 1.6 provides another specification to test which are the responsive segments of this sample by breaking the effect by education level. The results are stark: the increase in the likelihood of application amongst those with a work-limiting condition is due entirely to those with a high-school education or lower, while any negative effect that might be accruing in the general population derives from those with a college degree or higher. This result is predictable: these individuals with less education may be generally less informed about their suite of Social Security benefits, and the straightforward provision of DI information in the Statement is novel.

Although the overall positive effect is driven entirely by those with self-reported work-limiting conditions, not all work-limiting conditions are alike. Since the mid-1980s, the growth in DI rolls has not been uniform across disabling conditions: there have been disproportionate increases in musculoskeletal conditions, largely related to pain, and non-retardation mental disorder cases (Autor and Duggan 2006). Concern has arisen that the residual work capacity of these new enrollees is disproportionately higher (Maestas et al. 2013). Below, I address the question of whether those induced to enter the program by Statement receipt skew toward these conditions.

I separate the Statement's impact on differing disabling conditions, providing evidence on the mix of conditions amongst those responsive to Statement receipt. To illustrate the prevalence and interaction of these conditions, Table 1.7 shows the cross-tabulations of disability frequency among the person-years in the sample, both by absolute count and as a correlation matrix. The disabling conditions that I include in my analysis are limitations to Activities of Daily Living (e.g. eating, getting out of bed), limitations to Instrumental Activites

Table 1.7

Matrix of Number of Individuals with Any Given Disability Reporting Another Disability

Counts

Any	ADL	iADL	Mental	Back Problem	Work-Limiting
ADL	2464	565	1550	1212	1442
iADL	565	3568	770	1279	850
Mental	1199	579	8817	2690	2218
Back Problem	1212	1279	4304	9838	2400
Work-Limiting	1442	850	3183	2400	5735

Fraction of Row

Any	ADL	iADL	Mental	Back Problem	Work-Limiting	Total
ADL	1.00	0.23	0.63	0.49	0.59	2464
iADL	0.16	1.00	0.22	0.36	0.24	3568
Mental	0.14	0.07	1.00	0.31	0.25	8817
Back Problem	0.12	0.13	0.44	1.00	0.24	9838
Work-Limiting	0.25	0.15	0.56	0.42	1.00	5735

ADL - Activities of Daily Living (e.g. eating, getting out of bed)
iADL - Instrumental Activities of Daily Living (e.g. using cash, using a telephone)
Mental - Scoring above a 1 on the CESD scale
Work-limiting - Self-reporting any work-limiting condition

Source: Health and Retirement Study, Waves 1-7

of Daily Living (e.g. using a telephone, handling money), mental depression conditions defined as scoring above a 1 on the Center for Epidemiologic Studies Depression scale, reporting a back problem, and the previously used reporting a health condition that limits the amount or kind of work the individual is capable of. It is important to note these are independent categories and can be overlapping or non-overlapping. For example, approximately 25% of those identifying a work-limiting condition do not report an ADL, iADL, mental, or back condition. As such, there is independent variation across these conditions, allowing for separate estimation of the Statement's effect across these subpopulations.[16]

[16]Appendix Table 1.1 presents estimates of the likelihood of reporting such a condition due to Statement-receipt alone by using the intra-cohort variation in the month of receipt relative to birthmonth of interviewees. This variation arises because receipt of the Statement during this time period generally occurs within three months of one's birthmonth. Therefore, there are individuals who are born in the same year (or even in the same month), but because of the timing of their HRS interview, some of these individuals will have received a Statement

Table 1.8

Effect of Statement Receipt on DI Application, by Self-Reported Disabling Condition

	DI Application			
	Binary Condition Variables			Number of Conditions Variables
	(1)	(2)	(3)	(4)
Statement Receipt	-0.002	-0.004	-0.008***	
	[0.002]	[0.003]	[0.003]	
Back Problems	0.017***	0.010***	0.002	
	[0.004]	[0.003]	[0.003]	
Mental	0.020***	0.016***	0.011***	-0.02
	[0.003]	[0.003]	[0.002]	[0.044]
ADL		0.090***	0.057***	0.018
		[0.010]	[0.010]	[0.025]
iADL		0.010*	0.006	0.004
		[0.006]	[0.005]	[0.008]
Work-Limiting			0.081***	0.081**
			[0.010]	[0.040]
Back X Statement	0.017***	0.005	-0.005	
	[0.006]	[0.0055]	[0.005]	
Mental X Statement	0.014***	0.004	-0.001	0.006
	[0.006]	[0.005]	[0.004]	[0.005]
ADL X Statement		0.096***	0.062***	0.017***
		[0.024]	[0.020]	[0.004]
iADL X Statement		0.120***	0.089***	0.027*
		[0.027]	[0.024]	[0.016]
Work-Limiting X Statement			0.088***	0.054
			[0.019]	[0.018]
Person-Years	40308	40308	40308	40308
R-squared	0.033	0.108	0.191	0.158

Note: Linear probabiliy regression (weighted) using individuals 50-64 from the HRS, 1992-2004. Person-year is the unit of analysis. Individuals followed until the year in which they apply for Disability Insurance or Supplemental Security Income. Dependent variable is whether applied for DI in previous two years. Statement receipt defined as ever having received a Social Security Statement (except if applied for DI before Statement receipt). Work-limiting condition is self-reported work-limitation in the previous year. All regressions control for gender, educational attainment, and reduction in OAI benefits due to rising Normal Retirement Age. Sample limited to living, age 50 to 64, and those fully insured at the beginning of the sample. All regressions control for Age Group X Year Dummies, which correspond to a separate dummy for each 5 year age group (50-54, 55-59, 60-64) in each year. Standard errors in brackets, two-way clustered at the year and birthyear levels. Binary variables correspond to having any condition in category, while continuous variables correspond to the number of these conditions one has.

*** p<0.01, ** p<0.05, * p<0.1

when asked if they have a disabling condition, while others will not have. Exploiting this intra-cohort variation in the relative timing of Statement receipt and HRS interview, I test whether Statement receipt has a direct effect on reporting these disabling conditions. For ADL, iADL, mental, or back conditions, there is no statistically significant difference in reporting before or after Statement receipt within a cohort. On the other hand, for a work-limiting condition, there

Table 1.8 presents the separate marginal effects on DI application of these conditions and their interaction with Statement receipt. The first three columns provide In Column 1, the Statement greatly increases the marginal likelihood of DI application of individuals with either depression or a back problem. However, these increases disappear when including ADL- and iADL-reported effects, implying that their addition to DI application after Statement receipt is channeled entirely through how they affect one's daily life. Moreover, including the Statement's effect on the work-limited population reduces the Statement's effects on the ADL and iADL population although they retain their statistical signficance.

The results in Table 1.8 show that the effect of Statement receipt on those with mental or back conditions is small and significant only in so much as these conditions interfere with an individual's ability to work or conduct daily activities. There is a much stronger Statement effect that independently impacts those with conditions that interfere with Activities of Daily Living or Instrumental Activities of Daily Living, suggesting that the Statement increases the likelihood of DI application disproportionately among those who are medically eligible for the program. Additionally, the likelihood of DI application increases the more ADLs or iADLs and individual reports, suggesting that the applicant on the information margin is disproportionately more disabled, in contrast to the finding in the literature that the applicant on the acceptance margin is healthier.

Although the previous tables demonstrate that the presence of a work-limiting disability has a clear mediating role in the impact of Statement receipt

may be a slight increase in the likelihood of reporting; however, the point estimate is an order of magnitude lower than both the base-rate of reporting of a work-limiting condition and the increase in DI application for those reporting a work-limiting condition, suggesting that the vast majority of those responding to Statement receipt in Tables 1.3 and 1.8 are those previously identifying such a condition.

Table 1.9

Effect of Statement Receipt on DI Application, by DI Benefit Quintile

	DI Application	
	(1)	(2)
PIA Quintile		
Bottom	-	-
	-	-
Second	0.0015	0.0014
	[0.0016]	[0.0016]
Middle	-0.0016	-0.0017
	[0.0014]	[0.0015]
Fourth	-0.0038*	-0.0036
	[0.0021]	[0.0021]
Top	-0.0071**	-0.0068**
	[0.0031]	[0.0032]
PIA Quintile X Statement Receipt		
Bottom	-0.01	-0.01
	[0.01]	[0.01]
Second	-0.028	-0.03
	[0.05]	[0.05]
Middle	-0.03	-0.031
	[0.04]	[0.04]
Fourth	-0.03	-0.034
	[0.04]	[0.04]
Top	-0.03	-0.031
	[0.04]	[0.04]
PIA Quintile X Work-Limited		
Bottom	0.115***	0.114***
	[0.043]	[0.043]
Second	0.087***	0.087***
	[0.016]	[0.016]
Middle	0.113***	0.113***
	[0.017]	[0.017]
Fourth	0.098***	0.098***
	[0.031]	[0.031]
Top	0.078***	0.079***
	[0.014]	[0.014]
PIA Quintile X Work-Limited X Statement Receipt		
Bottom	0.079	0.076
	[0.062]	[0.061]
Second	0.128***	0.125***
	[0.033]	[0.033]
Middle	0.148***	0.145***
	[0.038]	[0.037]
Fourth	0.154***	0.152***
	[0.045]	[0.045]
Top	0.06**	0.06**
	[0.025]	[0.025]
Age Fixed Effects	Yes	No
Year Fixed Effects	Yes	No
Age-Group X Year Fixed Effects	No	Yes
Person-Years	31598	31598
R-squared	0.182	0.187

Note: Linear probabiliy regression (weighted) using individuals 50-64 from the HRS. Person-year is the unit of analysis. Individuals followed until the year in which they apply for Disability Insurance or Supplemental Security Income. Dependent variable is whether applied for DI in previous two years. Statement receipt defined as ever having received a Social Security Statement (except if applied for DI before Statement receipt). Work-limiting condition is self-reported work-limitation in the previous year. All regressions control for gender, educational attainment, and reduction in OAI benefits due to rising Normal Retirement Age. Sample limited to living, age 50 to 64, and those fully insured at the beginning of the sample. Standard errors in brackets, clustered at the cohort-year level.

*** p<0.01, ** p<0.05, * p<0.1

of DI application, this effect need not be uniform across potential DI benefit levels. To this point, Table 1.9 reports the Statement's effect along the potential DI benefit, or Primary Insurance Amount (PIA), distribution. To estimate these effects, each individual is sorted into a PIA quintile based on their DI PIA in the latest year before Statement receipt for which earnings histories are available. These DI benefit quintiles are then interacted with work-limiting conditions and Statement receipt. There is no statistically significant Statement effect at any PIA quintile for the non-work-limited population.

The large positive impact on the work-limited population, on the other hand, is not uniform across PIA quintiles: in absolute magnitude, the Statement's effect is highest in the middle three quintiles and lowest for the top and bottom quintiles. The second through fourth quintiles experience the greatest increase over their baseline rate, while the top and bottom quintiles are the least affected, the latter not statistically significantly at all. Given the progressive structure of OASDI benefits, the bottom quintile has the lowest PIA benefit, while the top quintile has the lowest replacement rate. The middle quintiles strike a balance between these two extremes, so the group most responsive to Statement receipt has both high PIA benefits and a high replacement rate.

Although the analysis thus far has estimated the impact of ever having received a Statement on DI application, the phase-in schedule depicted in Figure 1.2 shows that not only is there variation in when an individual first receives a Statement, but there is further variation in receipt of subsequent Statements. To more precisely estimate the timing of the effect of Statement receipt on DI application, I create more variables in addition to the current "Ever Having Received a Statement" (now referred to as "At Least 1 Statement"). I include "At Least 2

Statements" and "Years Since Last Statement" variables. This second variable is broken down two ways - one, as a continuous variable, albeit containing only three non-zero values (1,2,3), and two, as a dummy variable for each non-zero value.

In order to exploit the variation present in both first and second Statement receipt, I construct a yearly dataset instead of the biennual HRS interview frequency. These data are correspondingly noisier and rely more heavily on the accuracy of both Statement receipt and self-reported DI application dates, but they allow for separate estimation of the diffusion of information on the DI application decision, relaxing the previous assumption of a constant post-Statement effect. Table 1.10 shows that for the subpopulation identifying a work-limiting condition, the effect of the Statement is gradual - it is insignificant in the year of receipt and increases as time progresses, especially after second Statement receipt. Column 2 shows results that include a dummy variable for each year after receipt and demonstrates that although for both groups the Statement's effect takes one year before it becomes statistically significant, its effect then fades afterward. For the work-limited population the effect remains significant into the second and third years afterward, while for the general population it does not. The information intervention requires a year before its strongest effect is felt, and then fades afterward, slowly for the work-limited population. The second Statement reinforces the previously estimated effects.

Table 1.11 breaks down the effect by age, demonstrating that the Statement's effects are driven by younger individuals. This analysis provides some evidence on whether the effect identified above is due to "shifting forward" of application behavior or, rather, whether it reflects new applicants. If this shifting were

Table 1.10

Estimated Effect of Statement Receipt, by Time Since Statement and Number of Statements

	DI Application	
	(1)	(2)
At Least 1 Statement	0.002	-0.001
	[0.008]	[0.007]
Years Since Last Statement (continuous)	-0.009	-
	[0.007]	-
1 Year Since Last Statement	-	-0.02
	-	[0.02]
2 Years Since Last Statement	-	-0.017
	-	[0.011]
3 Years Since Last Statement	-	0.0002
	-	[0.007]
At Least 2 Statements	-0.012	-0.01
	[0.003]	[0.01]
Work-Limiting Condition (WL)	0.007*	0.007*
	[0.004]	[0.004]
WL X At Least 1 Statement	-0.011	-0.015
	[0.012]	[0.013]
WL X Years Since Last Statement	0.097***	-
	[0.034]	-
WL X 1 Year Since Last Statement	-	0.226***
	-	[0.079]
WL X 2 Years Since Last Statement	-	0.197***
	-	[0.065]
WL X 3 Years Since Last Statement	-	0.07***
	-	[0.019]
WL X At Least 2 Statements	0.031***	0.035**
	[0.014]	[0.014]
5-year Age Group X Year Dummies	Yes	Yes
Fully Insured Sample	Yes	Yes
Person-Years	63286	63286
R-squared	0.028	0.032

unit of analysis. Individuals followed until the year in which they apply for Disability Insurance or Supplemental Security Income. Dependent variable is whether applied for DI in previous two years. Statement receipt defined as ever having received a Social Security Statement (except if applied for DI before Statement receipt). Work-limiting condition is self-reported work-limitation in the previous year. All regressions control for gender, educational attainment, and reduction in OAI benefits due to rising Normal Retirement Age. Sample limited to living, DI covered individuals, age 50 to 64. All regressions control for Age Group X Year Dummies corresponding to a separate dummy for each 5 year age group (50-54, 55-59, 60-64) in each year. Standard errors in brackets, two-way clustered at the year and birthyear levels.

*** p<0.01, ** p<0.05, * p<0.1

Table 1.11

Effect of Statement Receipt on DI Application by Age Group and Work-Limiting Condition

	DI Application		
	(1)	(2)	(3)
50-54 X Statement	0.025***	-0.011*	-
	[0.010]	[0.0055]	-
55-59 X Statement	0.007**	-0.0072***	-
	[0.003]	[0.0024]	-
60-64 X Statement	-0.0003	-0.003	-
	[0.003]	[0.0027]	-
Work-Limiting X 50-54 X Statement	-	0.187***	-
	-	[0.048]	-
Work-Limiting X 55-59 X Statement	-	0.115***	-
	-	[0.025]	-
Work-Limiting X 60-64 X Statement	-	0.055***	-
	-	[0.013]	-
Statement	-	-	0.003
	-	-	[0.004]
Years Since Statement	-	-	-0.003
	-	-	[0.004]
Work-Limiting	-	-	0.087***
	-	-	[0.014]
Work-Limiting X Statement	-	-	0.073***
	-	-	[0.023]
Work-Limiting X Statement X Years Since	-	-	0.012
	-	-	[0.017]
5-year Age Group X Year Dummies	Yes	Yes	Yes
Person-Years	40308	40308	40308
R-squared	0.182	0.181	0.162

Note: Linear probabiliy regression (weighted) using individuals 50-64 from the HRS. Person-year is the unit of analysis. Individuals followed until (inclusively) the year in which they apply for Disability Insurance or Supplemental Security Income. Dependent variable is whether applied for DI in previous two years. Statement receipt defined as ever having received a Social Security Statement (except if applied for DI before Statement receipt). Work-limiting condition is self-reported work-limitation in the previous year. All regressions control for gender, educational attainment, and reduction in OAI benefits due to rising Normal Retirement Age. Sample limited to living, DI fully insured individuals (if indicated), age 50 to 64. Age Group X Year Dummies correspond to a separate dummy for each 5 year age group (50-54, 55-59, 60-64) in each year. "Years Since" variable is the number of years since first Statement receipt. Standard errors in brackets, two-way clustered at the year and birthyear levels.

*** p<0.01, ** p<0.05, * p<0.1

the dominant explanation, then the Statement's effect on the oldest age group would have to be negative (or, more generally, it could not be positive for every age group). However, Column 1 shows that even for the general population, the Statement effect for those 60-64 is approximately zero and tightly estimated. If the average results found above were due to "shifting forward" of inevitable applicants, then the Statement effect for the oldest at-risk workers would have to be strongly negative to make up for those applicants who applied earlier. That

this effect is zero for these older workers implies that any forward shifting is overwhelmed by the number of new applicants. This effect is further supported by breaking down the impact by work-limiting condition, as shown in Column 2. For the work-limited population, the Statement's marginal effect halves with every increase to the next 5-year age group. However, it still has a highly statistically significant and substantial impact on those 60-64, so for no group in the work-limited population is the effect negative or even statistically indistinguishable from zero, and it is this population that is driving the increase in the aggregate rolls. To the extent that there is shifting forward, it is swamped by the influx of new applicants. Column 3 provides additional evidence that shifting forward is not the driving story in this analysis; if it were, then as individuals exited the sample due to DI application, the remaining pool would be less likely to apply for DI, since their applicants have already applied. Therefore, the trend effect of the Statement should be strongly negative as all the eventual DI applicants leave the sample. However, as Column 3 indicates, the point estimate of this effect is positive, albeit statistically insignificant, once again demonstrating that this effect is not due to shifting forward of eventual applicants. [17]

Table 1.12 alters the above analysis by studying DI entrance, corresponding to DI application and eventual acceptance. As such, this new dependent variable "DI entrance" is a strict subset of the previous "DI application," since those who applied and were not accepted have a zero value for the dependent variable. The rest of the analytic framework, regression design and sample creation, is identical. The results indicate that there is a corresponding increase in DI entrance; indeed, most induced DI applicants are eventually accepted onto the

[17] It is worth noting here that even if "shifting forward" were the dominant explanation for the observed effect, it would still have a large impact on the size of the DI rolls, since applying 5-10 years earlier when previously one would only have been on the rolls for 1-5 years represents a large increase in the time spent on the rolls and the total benefits received.

Table 1.12

Effect of Statement Receipt on DI Entrance, by Work-Limiting Condition

	DI Entrance	
	(1)	(2)
Statement Receipt	0.010***	-0.001
	[0.004]	[0.007]
Work-Limiting Condition	-	0.076***
	-	[0.018]
Statement X Work-Limiting Condition	-	0.097***
	-	[0.032]
5-year Age Group X Year Dummies	Yes	Yes
Fully Insured Only	Yes	Yes
No-Statement DI Entrance Mean		
General Population	0.016	0.016
N	40308	40308
R-squared	0.013	0.137

Note: Linear probabiliy regression (weighted) using individuals 50-64 from the HRS. Person-year is the unit of analysis. Individuals followed until the year in which they apply for Disability Insurance or Supplemental Security Income. Dependent variable is whether applied for DI in previous two years and eventually accepted onto the DI rolls. Statement receipt defined as ever having received a Social Security Statement (except if applied for DI before Statement receipt). Work-limiting condition is self-reported work-limitation in the previous year. All regressions control for gender, educational attainment, and reduction in OAI benefits due to rising Normal Retirement Age. Sample limited to living, DI covered individuals, age 50 to 64. Age Group X Year Dummies correspond to a separate dummy for each 5 year age group (50-54, 55-59, 60-64) in each year. Standard errors in brackets, two-way clustered at the year and birthyear levels.

*** p<0.01, ** p<0.05, * p<0.1

rolls. In fact, the implied acceptance rate of 82%[18] is greater than the previous mean of 77%. This increase in acceptance rates is similar for work-limited applicants, from 79% for non-Statement recipients to 84% to Statement recipients, and almost all older induced applicants are accepted onto the DI rolls. Therefore, the applicants induced to apply for DI because of Statement receipt are on average more likely to be medically eligible for the DI program, thereby shrinking the misclassification errors identified previously in the DI literature (Bound 1989, Maestas et al. 2013).

Tables 1.3, 1.8, and 1.12 all demonstrate an overall increase in the likelihood of DI application driven by new applicants who are just as likely, if not more so,

[18]This value is calculated by dividing the marginal acceptance effect plus the base acceptance rate by the marginal application effect plus the base application rate.

to be accepted onto the DI rolls.[19] As will be estimated in the next section, this combination implies that the Statement's provision has significantly contributed to the rise of the DI rolls over this period.

1.7 Implied Effect on DI Rolls

The analysis above identified an aggregate increase in the likelihood of DI application upon Statement receipt over a sample period of 1992-2004. Since the DI rolls were growing over this time period, both absolutely and as a fraction of working-age adults, the question arises as to how much of this increase can be attributed to those entering the rolls due to Statement receipt.

In this section, I perform a back-of-the-envelope calculation to approximate the implied increase in the size of the DI program due to the large effect estimated above. This is not a precise estimate: it is intended to provide a sense of how the above increase in DI application rates translates to the increases in the size of the DI rolls. To calculate the number of awards that were due to Statement receipt, I start with the actual awards from Social Security's *Annual Statistical Supplement* for the years 1992-2004, broken down by age group. These figures show how many of the awards in a given year went to those aged 50-54, 55-59, 60-61, and 62-64. I then calculate the fraction of these awards that were induced by Statement receipt, given my estimates above, and subtract these Statement-induced awards from the actual awards to construct a no-Statement counterfactual series of DI rolls.

[19] Additional interactions with prior health insurance coverage has been estimated, although the results of that analysis demonstrate no statistically significant effect of the Statement application. It appears that the Statement's novelty amounts to the existence of DI and its corresponding monthly benefit.

In particular, I estimate the counterfactual awards (A_0) figures starting with the actual awards (A_1):

$$A_1 = A_0(1 + S * \alpha)$$

where S is the fractional increase in applicants and α is the acceptance rate of these applicants (see footnote 20 for an explanation of this calculation). This leads to the number of additional DI recipients of:

$$A_1 - A_0 = A_1 \left(1 - \frac{1}{1 + S * \alpha}\right)$$

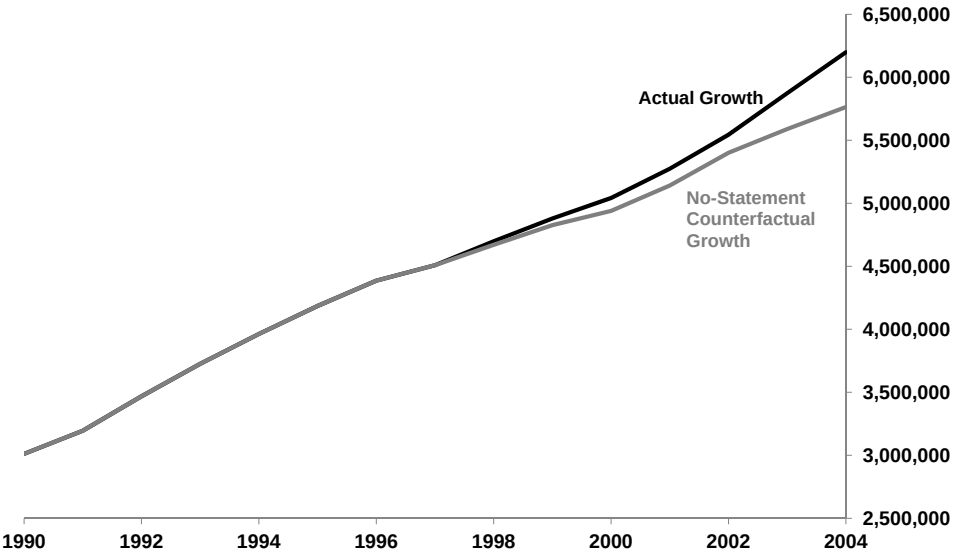
To this end, I determine who received a Statement and responded to it by entering DI by assigning to each age group's awards in a given year the fraction of that age group that received a Statement three years previously. I selected three years since the aggregate DI application Statement effect was shown to have a more gradual effect in Table 1.10. I assume an increase in the probability of DI application of 62%, which is the estimate from Column 3 of Table 1.3. Furthermore, I assume an acceptance rate onto the DI rolls of 80% given application (which, when applied to the increased application rate, is approximately the increase estimated in the DI entrance analysis in Table 1.12).

Last, I assume it takes one year from application to acceptance, since wait times between application and initial determination average 131 days and between application and reconsideration, the first appeal stage granted to denied applicants, 279 days in 2006 (O'Carroll 2008).[20] Using these assumptions and the age-specific awards in each year, I then calculate how many awards each year can be attributed to increased application and subsequent acceptance due

[20] Although subsequent appeal results in much longer delays until possible award, 83% of cases were resolved by the reconsideration stage in 2006.

to Statement receipt. By 2004, of the 6,198,271 disabled workers on the DI rolls, 393,449 of them were due to Statement receipt. Figure 1.3 shows the difference between the actual rolls and what the rolls would have been in the absence of the Statement according to the above calculations.

Figure 1.3: Actual Growth in DI Disabled Worker Rolls and No-Statement Counterfactual, 1995-2004

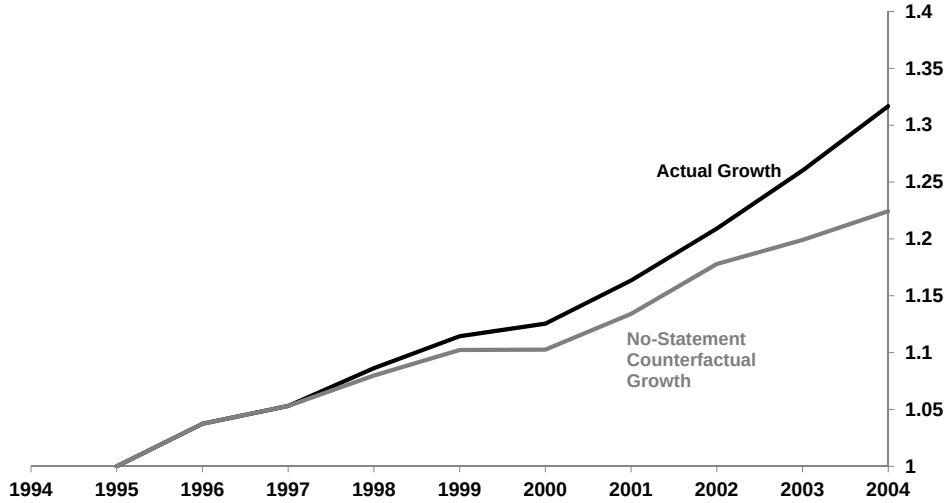


Note: Assumes post-Statement increase in DI application likelihood of 62% among those aged 50-64, 80% acceptance rate onto rolls, 3 year delay between Statement receipt and application, and 1 year delay from application to acceptance. Age-group specific awards sourced from Social Security's *Annual Statistical Supplement*, Various Years

Figure 1.4, on the other hand, shows these rolls as a fraction of the working-age population and indexed to one in 1995. By 2004, these "per-capita" DI rolls had increased by 32%. If the Statement had not been sent out, this growth would have been 25%. That is, 7 percentage points, or about 20%, of the growth in the DI rolls over this period can be explained by the Statement's provision alone.

I implicitly assume in the above calculation that the overall effect was entirely new applicants. However, if "shifting forward" accounts for an impor-

Figure 1.4: Actual Growth in DI Disabled Worker Rolls as Fraction of Working Age Population and No-Statement Counterfactual, 1995-2004, Indexed to 1 in 1995



Note: Assumes post-Statement increase in DI application likelihood of 62% among those aged 50-64, 80% acceptance rate onto rolls, 3 year delay between Statement receipt and application, and 1 year delay from application to acceptance. Age-group specific awards sourced from Social Security's *Annual Statistical Supplement*, Various Years

tant component of that overall effect, this component still has first order effects on the size of the DI rolls, since these individuals are at least doubling, if not tripling or more, their time spent in the program. The portion of the DI rolls' increase explained by Statement receipt will be qualitatively unchanged.

The analysis of the effect of the Statement on DI rolls stops in 2004 because that is where the analytic sample ends, and any additional projection of the Statement's effect will be difficult given the lack of variation in Statement receipt, requiring assumptions over how large the pool of individuals sensitive to the information in the Statement is (i.e. whether the effect falls since those who respond to the Statement have already applied for DI). Despite this limitation, Figures 1.3 and 1.4 show a large percentage of the growth in the DI rolls over this period can be explained by a previously unstudied influence on DI

decision-making: the Social Security Statement.

1.8 Discussion and Conclusion

Using the Health and Retirement Study panels matched to administrative Social Security records and the variation in information provision arising from the staggered introduction of the Social Security Statement in the late 1990s, I analyze the effect of revealing personalized DI benefit information on DI application rates among older workers. A central finding of this analysis is that this information provision had a positive, significant, and substantial effect on DI application rates, increasing the likelihood of applying for DI by about 62%. Moreover, this rise in the likelihood of DI application increased the targeting efficiency of the DI program, since it was driven entirely by those with a work-limiting condition who were not working.

Unlike previous work finding no average impact of the Statement on Social Security decision-making (Mastrobuoni 2011), I focus on Disability Insurance behavior instead of retirement timing, for which the Statement provides immediately relevant information for a potentially little-known program among Statement recipients. Additionally, to my knowledge there has been no previous research studying the role of information in the DI application decision. This paper thus contributes to the literature on information costs in social program application and take-up, adding a perspective on the importance of information in disability program behavior.

My initial analysis had certain drawbacks: the possibility of individuals "shifting forward" their application decisions, the use of self-reported appli-

cation data, an assumed structure of a constant Statement effect, and a focus on older workers. In my attempt to estimate the extent of any "shifting forward" of DI application behavior, I find that DI application rates among workers age 60 and over still increases after Statement receipt and there is no negative trend in DI application rates in the years that follow Statement receipt, implying that any forward shifting of DI application is overwhelmed by the number of entirely new applicants. A separate analysis of how the effect of Statement receipt changes depending on how long ago one received a Statement demonstrates that much of the effect is front-loaded and fades over time. However, I do not estimate how Statement receipt affects the general adult population's DI behavior, and whether the strong and positive overall effect of Statement receipt varies widely for younger workers is an avenue for future research.

My estimates imply that these new applicants induced to apply for, and over 80% of whom are accepted onto, the DI rolls, account for approximately 7 percentage points of the 32% rise in per-capita DI rolls from 1995 to 2004. Consistent with previous work on the EITC and various social programs, I find that widely disseminated, personalized information about program eligibility and benefit levels can have a large effect on application behavior. Although the analysis in this paper suggests both that the response is driven by those already reporting a work-limiting condition and that there is no decrease in acceptance after application, the DI-related information presented in the Statement is asymmetric. It displays only the benefit available if one immediately exits the labor force, while omitting the increases in Social Security benefits accrued from additional work or projections of accrued income from current earnings versus benefit receipt. Careful study should be made as to how the information environment can affect those with work-limiting conditions, since provision of this information can

have large effects on DI application, targeting, and the resulting size and fiscal sustainability of the program itself.

CHAPTER 2

THE EFFECT OF SOCIAL SECURITY (MIS)INFORMATION ON THE LABOR SUPPLY OF OLDER AMERICANS

Co-authored with Michael F. Lovenheim

2.1 Introduction

A central question in economics is how information affects decisions, especially when this information is imperfect. Older workers' retirement behavior is a particularly relevant area in which partial information may lead to sub-optimal decisions, as the incentives embedded in pension plans often are difficult to understand. Evidence points to American workers having rather poor knowledge of their pension and social security wealth (Gustman and Steinmeier 2001, Mastrobuoni 2011). Thus, there is clear scope for information-based interventions that can help workers make optimal intertemporal labor supply and private savings decisions. At the same time, if the information workers receive is misleading, it may cause optimization errors that render them worse off.

In this project, we use the differential timing of the Social Security Statement, phased in from 1994 to 2000 according to age, to examine the role information about Social Security wealth plays in labor supply decisions of older workers. The fact that different-aged workers received the Statement in different years allows for exogenous cross-cohort differences in the timing of information. Furthermore, workers receive multiple statements that are staggered over several years depending on their birth cohort, which allows us to examine how workers

respond to updated Social Security wealth information. A central motivation of this paper is the fact that the Statement itself provided very limited information to workers: it informed them of their *projected* Social Security monthly benefit at ages 62, Full Retirement Age (FRA), and 70, assuming constant earnings growth until these ages. As a result, it was difficult if not impossible for workers to use the information contained in the Statement to forecast how changes in their labor supply would impact their future benefits. The information also was presented in such a way that workers may have thought the wealth shown was *accumulated* wealth that they would have if they stopped working today (even if they did not claim benefits until 62 or the FRA). This highlights the importance of observing worker reactions to subsequent Statements, when they would be able to observe how their labor supply changes affected their Social Security benefits.

The introduction of the Statement recently has been used to study the effect of retirement benefit information on retirement timing (Mastrobuoni 2011). Although this paper found that the Statement increased the accuracy of Social Security benefit predictions, it found no effect, on average, of having received a Statement on the timing of Social Security claiming or on the timing of self-reported retirement. This paper is very important in demonstrating that the Social Security Statement increased older workers' knowledge of their retirement wealth. However, the analysis of a binary claiming decision and retirement decision can miss many of the ways in which workers' labor supply responds to information. For one, the transition to retirement is not binary. Older workers tend to reduce their labor supply quite dramatically on the intensive margin before leaving the labor force altogether, and they also re-enter the labor force after they first leave (Rust and Phelan 1997). Both of these behaviors are not captured

by a retirement indicator variable. In addition, there are large spikes at the early and full Social Security retirement ages, which likely are due to the incentives embedded in the Social Security system as well as rule-of-thumb behavior and interactions with other government programs and work rules.

The large retirement spikes at these ages makes it difficult to observe any impact of an intervention on a binary retirement measure, when so many individuals are not on the decision-making margin. Instead of examining the binary retirement decision with few marginal decision-makers, we focus on the labor supply responsiveness on the intensive margin. Because of the often slow (and non-monotonic) transition from full-time work to full-time retirement, examining direct labor supply measures will allow us to examine in far more detail how labor supply decisions among older workers are influenced by this information intervention. The second main contribution of our paper is to examine the dynamic responses of workers to partial Social Security wealth information, i.e. the benefit projections based on *constant* real earnings. That is, does the partial nature of the information provided cause workers to make "mistakes" that are then corrected when the information is updated? To our knowledge, this question has not been addressed by any prior research.

Using the timing of the rollout of the Statement by age, combined with restricted-access Health and Retirement Study (HRS) data that include Social Security earnings histories on workers aged 40-61, we first estimate the average effect of Statement receipt on hours worked as well as how the treatment effects vary across the (pre-Statement) distribution of hours worked and worker age. In particular, treatment effect heterogeneity across the hours worked distribution is important to identify: workers who work few hours may seek to increase

their labor supply when they observe their projected Social Security benefits based on their current low hours level. High-hours workers may have the opposite reaction. For workers in the tails of the hours worked distribution, their current labor supply also is likely to have large impacts on their projected Social Security benefits.

Our main findings are that Statement receipt reduced annual hours worked by 198 hours, which is an 18.6% reduction relative to mean hours worked. The hours reductions come mainly from workers aged 50-61, with some suggestive evidence that younger workers increase their labor supply when they receive a Statement. We also find a large amount of heterogeneity across previous hours worked. Workers who work less than 10 hours per week increase their hours worked when they receive the statement by a large amount, on the order of 797 hours per year. The labor supply declines are due to workers with 40 or more hours per week, where workers decrease their hours worked by between 344 and 593 hours per year. These results are not simply a reflection of mean reversion, since we control for previous hours worked in our main specifications. We also show similar patterns exist for self-employment hours and for earnings. In short, our results point to large labor supply responses to receiving a Social Security Statement, which prior work looking at binary retirement indicators has missed.

We next examine the impact of second Statement receipt on labor supply. If workers mis-interpret the information they receive such that they think the wealth on the Statement is accumulated wealth, they may reduce hours worked. When they receive the second Statement, they will see their projected wealth has decreased, and if the initial hours reduction was an error, i.e. they had not taken

into account this decline in wealth, we should see these workers increase their hours worked. Our approach to this question is to estimate the difference in labor supply changes among those workers who decreased their hours worked after first Statement receipt and then received an updated Statement in the prior survey wave compare to workers who have the same time pattern of Statement receipt but who did not reduce their labor supply after first receipt. Of those who decreased earnings after first Statement receipt, and thus will see a lower projected benefit on their second Statement, receipt of this second Statement led to a subsequent increase in labor supply and earnings. Again, this is not just mean reversion: workers who reduced their labor supply after first receipt but who have not yet received the second Statement do not increase their labor supply (in fact it continues to decline).

We interpret this evidence as reflective of many workers misunderstanding the initial information and then attempting to correct decisions made based on that erroneous understanding. For some workers, the confusing nature of the information provided likely made them worse off. Since the HRS also includes extensive information on expected Social Security benefits, we directly test whether individuals who decrease their hours of work after their first Statement receipt report lower expected Social Security wealth. We find no evidence of this, which suggests the changes we are picking up after the second Statement are reflective of mis-information.

Finally, we use the exogenous rollout of the Statement as an instrument for workers expectations about Social Security benefits in order to estimate the elasticity of hours worked and earnings with respect to these expectations. These estimates are among the first in the literature to estimate such elasticities on the

intensive margin and to do so for relatively younger workers. We find consistent evidence that Statement-induced changes in expected benefits increase both hours worked and earnings. These results suggest that providing older workers below the early retirement age information that increases their expectations about future retirement benefits can generate increased labor supply amongst these workers.

Taken together, the results from this analysis suggest that information about retirement benefits has substantial effects on the labor supply of older, male Americans, whether this information is well-understood or not. Although in 2011, the Social Security Statement was no longer automatically sent out, a recent Social Security Advisory Board position paper (SSA 2013) suggests it will be reintroduced. Furthermore, workers can request a Statement or can generate the information on the Statement through the Social Security Administration Website. Our analysis sheds light on the potential value correct information on retirement wealth can have for workers but that much care needs to be taken to ensure the accuracy and transparency of this information in order to avoid worker errors from misinterpretation.

The structure of the paper is as follows: Section 2 describes essential components of Social Security benefits; Section 3 describes the Social Security Statement and its implementation; Section 4 discusses the data used in this analysis; Section 5 outlines our empirical methodology; Section 6 discusses results; and Section 7 concludes.

2.2 Old Age, Survivors, and Disability Insurance

Social Security, officially known as Old Age, Survivors, and Disability Insurance (OASDI), provides a suite of potential benefits to individuals who pay payroll taxes in the US. This program is large: in 2014, total expenditures were $785 billion. Chief among these programs in both saliency and size is the Old Age Insurance (OAI) portion. Because OASDI is a social insurance program, eligibility for benefits and benefit level are both based on one's entire history of covered earnings. OAI in particular requires individuals to have paid into the Social Security system with about 10 years of work for eligibility.[1]

For OAI benefit calculation, OAI uses the highest 35 years of an individual's annual earnings, indexed to average national wage growth, to then calculate an Average Indexed Monthly Earnings (AIME) amount. To determine one's Primary Insurance Amount (PIA), or benefit available upon retirement at the Full Retirement Age, the SSA then applies a progressive formula to the AIME. This PIA formula provides a 90% marginal replacement rate for the first $816 of an AIME, a 32% marginal replacement rate for the next $4,101 of the AIME, and a 15% marginal replacement rate for any remaining AIME. Hence one's benefit is always increasing in previous earnings, although at a decreasing rate. This PIA is then reduced if one opts for early retirement, available starting at age 62, or is increased if one delays collecting benefits after the Full Retirement Age, currently at 66. Additionally, an earnings test applies where benefits can be withheld if one claims benefits early yet continues to work.

Although a full discussion of program details is outside of the scope of this

[1] Specifically, the requirement to be insured is 40 Quarters of Coverage (QC), where in 2014 a QC is earned for every $1,200 of earnings, up to 4 per year.

paper, a few points are relevant to the analysis below: if a potential retiree does not have 35 years of earnings in their work history, then their AIME will contain zero earnings years. Because most individuals are earning at their highest levels late in their careers, there can be large returns to continue to work embedded in the Social Security system as these higher earnings years replace the zero years. As a result, there can be strong incentives for some older workers to continue to remain fully in the labor force when approaching Social Security retirement ages (Coile et al. 2002). The extent to which this is true depends on a worker's earning history, and thus workers with similar income levels may have vastly different returns to remaining in the labor force.

Additionally, individuals can collect benefits based on their spouses' work history, generally limited to 50% of their spouses' PIAs. Since we focus on older Americans in the 1990s in this sample, we limit our analysis to men largely to avoid the complex incentives facing women who may be deciding whether to collect benefits based on their husbands' work histories or their own. Because men have been shown to be largely unresponsive to the impact of their own claiming behavior on spousal benefits (Sass and Webb 2007), our sample represents individuals responding to their own retirement benefits.

A large literature measures the effects that the various components of the Social Security system have on labor supply, largely through changes in the parameters or scope of these components (Krueger and Pischke 1992, Friedberg 2000, Duggan et al. 2007, Mastrobuoni 2009). For a thorough discussion of decision-making and OAI more generally, Krueger and Meyer (2002) provide a comprehensive survey of studies that modeled retirement behavior.

However, most papers in this literature either implicitly or explicitly as-

sume that workers know their future benefits and can weigh alternative income streams when decision-making. Survey-based evidence, on the other hand, suggests that such sophisticated decision-making is rare. In the HRS, a sample of older Americans approaching retirement, only about 50% of respondents are able to provide any estimate of their expected Social Security benefits. Fewer than 30% of respondents are able to estimate their future benefits to within $1,500 (2000 dollars) per year (Gustman and Steinmeier 2001). These results suggest it is a very strong assumption that these respondents are not only aware of the range of complex retirement incentives they face but that they also factor these incentives into their decision-making years in advance. Chan and Stevens (2008) find that the result in the literature of responsiveness to pension incentives is entirely driven by the 20% of workers who perceive them correctly.

On the other hand, behavior entirely inconsistent with these incentives obtains among a substantial portion of the population. For example, family members for whom it is more advantageous to delay collecting benefits from spousal work histories after their own labor force exit are more likely to instead immediately collect benefits. Conversely, unmarried men who should immediately collect retirement benefits after exiting the labor force are more likely to delay this collection (Gustman and Steinmeier 2000).

More recent research has found that a majority of 50- to 70-year-olds understand future Social Security benefits are linked to one's participation in the labor force on the extensive margin. These individuals also largely understand the incentives behind the delayed retirement credits and widow benefits (Liebman and Luttmer 2012).[2] However, there are still aspects of the Social Security

[2]It is important to note that the evidence in Liebman and Luttmer (2012) comes from a survey they conducted in 2008, well after the Social Security Statement had first been introduced. At this time, most workers would have received yearly Statements for several years, which may

system about which individuals have a poor understanding, which and how many years of earnings are used in benefit calculations that impact intensive margin incentives. Moreover, individuals' ability to operationalize this knowledge is unclear, or at least incomplete, since these same authors found that a field experiment designed to increase knowledge about Social Security benefit and the incentives embedded in the benefit formula increased labor force participation by 4 percentage points, or over 5% (Liebman and Luttmer forthcoming). These effects, however, were limited to females, and there was no evidence on an impact on intensive margin labor supply. The intervention we study differs from theirs most notably in the fact that they did not provide any information about participants' Social Security wealth to them, whereas the Social Security earnings statement did. Thus, responses to the two types of information may be quite different.

Unfortunately, beyond this recent field experiment, understanding the effect of improving knowledge of these incentives has been largely stymied by a lack of exogeneity in information. Cross-sectional variation in program knowledge can be highly correlated with the benefits themselves. However, the staggered introduction of the Social Security Statement created exactly the variation in knowledge needed to study this topic.

2.3 The Social Security Statement

Starting in 1990, the Social Security Administration began providing standardized benefit statements for all individuals who requested them, and starting in

have increased their knowledge about their benefits and the incentives embedded in the Social Security System.

late 1994, Statements were *automatically* sent out. These Social Security Statements eventually were sent annually to all individuals who ever paid payroll tax 25 and older between 2000 and 2011 and contained personalized information about OASDI benefits upon retirement, disability, or death. The Appendix contains a fictional example Statement provided by SSA. In addition to providing information on these benefits, the Statement also displays each worker's historical covered earnings, allowing for a Statement recipient to check whether SSA has a correct record of his or her earnings history. Although previous research on the Statement finds a lack of any compelling effect of this information on retirement timing, it greatly increases the likelihood of an individual's correctly anticipating their OAI benefits (Biggs 2010, Mastrobuoni 2011).

While the Statement has, until recently, been sent to those 25 and older, it was phased in across different age groups in the late 1990s. The Statement was initially sent out to those age 60 and over in 1995, as well as all those turning 60 from 1995 onward. Additionally, in 1996, they were automatically sent to those 58 to 60; in 1997, 53 to 58; in 1998, 47 to 53; in 1999, 40 to 47; and in 2000, 25 and over.[3] Figure 2.1 illustrates which age groups received the Statement in which Fiscal Year, as well as the total number of Statements sent out. An "X" in an age-group by year cell indicates that a Statement was sent to that age-group in that year. This phase-in schedule provides a natural experiment in the provision of information about OASDI benefits in the late 1990s. As evident in Figure 1, there is variation by year and age in both first Statement receipt as well as in the timing of when individuals received the Statement a second time. We will discuss subsequent Statement receipt more fully below.

[3]The years described here correspond to SSA fiscal years, which start in October. The exact timing of Statement receipt depends on one's birth month, but approximately one third of those 60 and over received a Statement in 1994: those born October, November, or December 1994, or January 1995.

Figure 2.1: Social Security Statement Phase-In Schedule

	SSA Fiscal Year							
	1994	1995	1996	1997	1998	1999	2000	2001
61 and Older		X					X	X
60		X	X	X	X	X	X	X
58-59			X				X	X
53-58				X			X	X
47-53					X		X	X
40-47						X	X	X
25-40							X	X
Total Statements Sent (millions)	0	7	5.5	12.4	20.7	26.6	134.7	135.6

Note: SSA Fiscal Years are October of the preceding calendar year to September of the stated year. No Statements were sent out before Fiscal Year 1995, and all individuals with Social Security Numbers age 25 and over received a Statement from 2000 to 2011.

Previous research on this Statement has shown that once one controls for age and year, no other factors influence Statement receipt (Mastrobuoni 2011), and that, indeed, after having received these Statements, individuals are much more likely to be able to provide any estimate of their OAI benefits, and among those who already provided estimates, the accuracy of these estimates improves.

The Statement describes retirement benefits, based on an earnings level consistent with that of the past two years, if a retiree elects to receive benefits at the Early Eligibility Age (62), the Full Retirement Age (between 65 and 67, depending on birth cohort), and age 70. Some researchers have expressed concern that the static nature of these estimates is misleading, and conveying information on Social Security Wealth accrual rates by different earnings trajectories would be more relevant to the decision-making of potential beneficiaries (Jackson 2006).

Indeed, this is a central motivation for our paper. The only previous research on the effect of the Statement on Social Security behavior found no average change in timing of collecting Old Age Insurance, nor any change in the responsiveness of older Americans to the effect of additional earnings on these retirement benefits (Mastrobuoni 2011). However, there has been no analysis of the Statement's effect directly on labor supply of older Americans until this paper.

To provide a stronger sense of the variation in both first and second Statement receipt that we exploit in our analysis, Figure 2.2 shows the Statement receipt patterns of five adjacent birth cohorts from 1994 to 2001.[4] The shadings in each column allow one to track each cohort across columns to see the timing of first and second Statement receipt. Three of these cohorts (1936-1938) received their first Statement in 1996, while the younger two cohorts had to wait until 1997. Second Statement receipt patterns are even more disparate: we do not see the 1936 birth cohort receive a second Statement; the 1937 birth cohort receives a second Statement in the year directly after first receipt; the 1938 birth cohort receives a second Statement two years after first receipt; the 1939 birth cohort also experiences a two-year wait, but both their receipt years are one year later than the 1938 cohort; and the 1940 birth cohort received their first Statement in the same year as the 1939 cohort but must wait three years before their second Statement receipt. It is this substantial variation in both first and second Statement receipt that allows for the identification of the effect of the Statement separate from age and year fixed effects. We exploit the fact that otherwise similar cohorts have such markedly different Statement receipt patterns to identify the causal effect of the Statement information on labor supply of older workers.

[4]We include only men under the age of 62 in our analysis to avoid complex interactions with those who may already have claimed benefits.

Figure 2.2: Statement Receipt Pattern among 1935-1940 Birth Cohorts

	SSA Fiscal Year							
	1994	1995	1996	1997	1998	1999	2000	2001
61		X					X	X
60		X	X	X	X	X	X	X
59	1935		X				X	X
58	1936		X	X			X	X
57	1937			X			X	X
56	1938			X			X	X
55	1939			X			X	X
54	1940			X			X	X
53				X	X		X	X
52					X		X	X
51					X		X	X
50					X		X	X
49					X		X	X
48					X		X	X
47					X	X	X	X
46						X	X	X

2.4 Data

This paper uses the Health and Retirement Study panels, matched to Social Security earnings and benefits records. The HRS is a nationally representative panel survey of individuals over age 50 and their spouses. The survey elicits information about demographics, income, assets, health, cognition, job status and history, expectations, and insurance and is administered by the Institute for Social Research (ISR) at the University of Michigan. It consists of six cohorts:

1. The Initial HRS cohort, born between 1931 and 1941, first interviewed in 1992 and reinterviewed every 2 years;
2. AHEAD cohort, born before 1924, initially the separate Study of Assets

and Health Dynamics Among the Oldest Old, first interviewed in 1993, then in 1995, 1998, and subsequently every two years;

3. Children of Depression (CODA) cohort, born 1924 to 1930, first interviewed in 1998 and subsequently every two years;
4. War Baby (WB) cohort, born 1942 to 1947, first interviewed in 1998 and subsequently every two years;
5. Early Baby Boomer (EBB) cohort, born 1948 to 1953, first interviewed in 2004;
6. Mid Baby Boomer (MBB) cohort, born 1954-1959, first interviewed in 2010.

For this analysis, we use men in the first four cohorts only, since the fifth and sixth cohorts enter after the Statement has been universally provided to those 25 and older, so the last year covered in our sample is 2002 (corresponding to wave 6 of the survey). These panels are then matched to Social Security Respondent Cross-Year Summary Earnings, for which the match rate is approximately 72% among the cohorts we use and 66% overall for the Initial Cohort (Mitchell et al. 1996). These records provide earnings from 1951 to the year of the match. The match is imperfect due to two factors: approximately a quarter of respondents do not grant permission to have their administrative records matched, while the remaining unmatched individuals provided erroneous Social Security Numbers. Previous research using these matched data shows that for the Initial Cohort, the matched subset is an unbiased subsample (Kapteyn et al. 2006, Michaud and Van Soest 2008).

The largest problem when using the matched data is that the Social Security records are matched only up until a permission year, and for the vast majority of respondents in our sample there are only three permission years: 1992, 2004,

and 2008. In a permission year, an HRS respondent is asked again whether the survey administrators can match his or her SSA records up until that year. Therefore, an individual must stay in the HRS until 2004 for researchers to observe his or her records past 1992. These individuals represent a skewed sample of younger and healthier respondents. We therefore primarily use self-reported measures of earnings and hours-worked instead of administrative records.[5]

We focus our analysis on men, for two reasons: first, for this population of older workers, labor force participation rates of men are much higher than among women, and men represent the primary earners in their families. Second, because of their higher lifetime earnings, their Social Security Statement will be informative as to their retirement benefits, while their wives' will be much more likely to collect spousal benefits. We further limit our analysis to men under age 62, thereby avoiding the complex incentives facing someone who can choose to receive benefits immediately and for whom the Statement has different informational content. In effect, we are focusing only on men who can change their labor supply in anticipation of future Social Security benefits. Next, we calculate whether individuals have earned the 40 Quarters of Coverage in their lifetime to be fully insured for OAI benefits by using the administrative earnings records that start in 1951 for all matched individuals. We drop individuals who are not fully insured by 1991. Although they may subsequently work enough to gain OAI eligibility, their benefits will be very low and they represent an unusual sample of workers. Last, we include only those individuals who reported positive hours worked before having received a Statement. This limitation is intended to avoid interactions with other OASDI programs:

[5]When we use administrative data during our sample window in Appendix Table 2.6, we approach this sample skewing as a non-response bias and estimate a logit model of likelihood of rematching in 2004, then reweight these observations by the inverse probability of their inclusion in this sample (Carlson et al. 2001).

the first chapter in this dissertation shows that among HRS respondents who are not currently employed, Statement receipt is associated with increased Social Security Disability Insurance application. The analysis herein is targeted toward the retirement portion of Social Security, which necessitates dropping non-employed workers prior to Statement receipt.

Table 2.1 shows the effect of these sample restrictions on the size of our primary sample. Ultimately, there are 14,320 observations corresponding to 3,963 unique respondents that are in our sample.

Table 2.1

Sample Restrictions	Count
Unique HRS Respondents in 1992-2002 Window	30,671
Successful Match to SSA Records	21,633
Fully Insured for OAI	17,101
Under 62 and Male	6,781
Total Remaining Person-Years in Sample	28,165

Note: Sample counts from 1992-2002 Health and Retirement Study (waves 1 to 6), matched to SSA administrative records.

For variable construction, we draw from the RAND Corporation's pre-cleaned version of the HRS for self-reported earnings, hours worked, self-employment status, analytic weights, health status, IRA wealth, general assets

not including IRAs, and pension information. We use the HRS Tracker File for marriage status, birth and death information, and education. Last, we use HRS modules for expected OAI benefits at age 62 or 65. We calculate whether an individual had a second job before any Statement receipt, as well as the number of hours they worked in the year before the first Statement receipt. Tables 2.2a and 2.2b provide descriptive statistics on the variables we use in our analysis.

Finally, our primary analysis uses the HRS as a natural sample, as is common practice in the Social Security program analysis literature using the HRS (Burkhauser et al. 2004, Li and Maestas 2008, Mastrobuoni 2011). The primary reason for this is that the weights are not available in all years, and thus using them distorts the age composition of the sample. As a check on our results, weighted versions of all regressions are included in corresponding appendix tables and show our estimates are robust to using sample weights.

2.5 Empirical Methodology

Our goal in this analysis is to estimate the effect of Statement receipt on the labor supply of older male workers. The identifying assumption is that by controlling for age and year fixed effects, the only remaining systematic difference between adjacent cohorts in the pattern of the Statement's provision is the Statement itself. That is, no other factor that would influence labor supply decisions of this population is systematically related to the Statement's phase-in pattern across birth cohorts. This is the same assumption invoked by Mastrobuoni (2011). Given the idiosyncratic variation in both first and second Statement receipt timing illustrated in Figure 2.2 and that conditional on controlling for age and year,

Table 2.2a	Mean
Descriptive Statistics, Unweighted	(SD)
Dependent Variables	
Annual Hours Worked	1065.28
	(1,252.12)
Self-Employment Annual Hours Worked	227.79
	(764.36)
Self-Reported Annual Earnings	34,836.79
	(58,514.62)
Decreased Expected PIA	0.29
	(0.45)
ln(Self-Reported Earnings)	10.18
	(1.11)
ln(Hours Worked)	7.67
	(0.48)
Independent Variables	
Age	52.4
	(6.56)
White	0.803
	(0.398)
Married	0.491
	(0.500)
High School	0.493
	(0.500)
College	0.137
	(0.343)
More than College	0.133
	(0.340)
Ever Received Statement	0.389
	(0.488)
Ever Received 2 Statements	0.176
	(0.381)
Had Second Job Before 1st Statement	0.104
	(0.305)

Hours Worked Category Pre-Statement among those with Positive Hours Worked Pre-Statement

	All Hours Worked	Self-Employed Hours Worked
1 to 9 per Week	17.5%	71.92%
10 to 19 per Week	1.85%	0.93%
20 to 29 per Week	2.97%	1.20%
30 to 39 per Week	5.19%	1.58%
Exactly 40 per Week	22.99%	1.78%
Over 40 per Week	49.53%	22.60%

Note: Descriptive statistics from 1992-2002 Health and Retirement Study, matched to SSA administrative records, from sample restrictions outlined in Table 1, unweighted.

no other observable factor predicts Statement receipt (Mastrobuoni 2011), there is substantial evidence to support this assumption. The rollout of the Statement across cohorts lends itself naturally to a difference-in-difference analysis,

Table 2.2b Descriptive Statistics, Unweighted, cont'd	Mean (SD)
Received a Statement by w-1	0.37
	(0.48)
Decreased Hours between w-2 and w-1	0.18
	(0.39)
Decreased Hours X Statement by w-1	0.12
	(0.32)
Decreased Hours X 2nd Statement Between w-1 and w	0.08
	(0.27)
Decreased Earnings between w-1 and w-2	0.18
	(0.39)
Decreased Earnings X Statement by w-1	0.14
	(0.34)
Decreased Earnings X 2nd Statement Between w-1 and w	0.08
	(0.28)
Decreased Earnings between w-1 and w	0.25
	(0.43)
Decreased Earnings X Statement by w	0.13
	(0.34)
ln(Expected PIA)	6.72
	(0.54)

Note: Descriptive statistics from 1992-2002 Health and Retirement Study, matched to SSA administrative records, from sample restrictions outlined in Table 1, unweighted.

in which we compare changes in labor supply among those who receive a Statement to those who do not. The simplest model we use for estimating the effect of the Statement on labor supply is:

$$LS_{it} = \alpha_0 + \alpha_1 FS_{it} + Z_{it}\theta + X_{it}\Lambda + \epsilon_{it} \tag{2.1}$$

where LS_{it} represents labor supply, be it hours-worked across all jobs, self-employed hours-worked, or earnings; FS_{it} is an indicator for whether an individual i has received a Statement by time t. The parameter α_1, therefore, is our main coefficient of interest and represents the average effect of Statement receipt on the given labor supply measure. Z_{it} is a set of age and year indicators, so θ is a vector of corresponding fixed effects; and X_{it} is a set of demographic

factors shown in Table 2.2a that include marital status, education and race.

In the analyses to follow, X_{it} also includes how many hours per week an individual worked before receiving his or her first Statement, measured using 10-hour categories as well as an exactly 40 hours per week category. These pre-treatment labor supply controls serve two functions. First, they control for any heterogeneity across workers in pre-existing labor supply levels that may be correlated with the timing of the Statement rollout. Second, these controls account for mean reversion. Changes in labor supply always are potentially influenced by mean reversion, since both low-hours workers and high-hours workers will naturally tend to revert to the mean. Controlling for pre-treatment labor supply accounts for this mean reversion, however, and so we can identify whether workers in each hours group exhibit differential changes in labor supply when they receive the Statement relative to workers who work the same number of hours and who did not receive the Statement.

Equation (2.1) estimates the direct effect of ever having received a Statement on labor supply. Implicit in this specification is the assumption that the Statement has an immediate and constant effect on behavior, and that this effect is constant across different groups. However, there might be substantial heterogeneity across subgroups in responsiveness to the Statement that is of high interest. Although the assumption of an immediate and constant effect is not as strong in the context of our sample - biennial waves with at most 4 waves of post-Statement observation - we nevertheless relax it going forward by examining the effect of second Statement receipt. Furthermore, we allow for heterogeneity in the effect of the Statement across distinct subgroups of our sample.

To that end, we use the much more flexible specification:

$$LS_{it} = \alpha_0 + \alpha(FS_{it}I_{FS}X_{it}) + \beta(SS_{it}I_{SS}Y_{it}) + Z_{it}\theta + X_{it}\Lambda + Y_{it}\Omega + \epsilon_{it} \tag{2.2}$$

where α is now a vector of coefficients, FS_{it} is a vector with each entry either one or zero depending on whether the individual i has received a Statement by time t, X_{it} is a set of individual characteristics, and the diagonal matrix I_{FS} allows us to interact these characteristics with Statement receipt to arrive at subgroup-specific Statement effects. Furthermore, we include the possibility of second Statement receipt SS_{it} having an independent effect on labor supply, and allow this effect to differ across different subgroups Y_{it}, which may be the same or distinct from X_{it}. It is these I_{FS} and I_{SS} matrices that differ across specifications. One can note that equation (2.2) nests equation (2.1), if I_{SS} is a zero matrix and I_{FS} has only one non-zero entry for the constant entry of X_{it}.

The first set of specifications, presented in Tables 2.3 through 2.5, examine the effect of the first Statement interacted with various demographic or previous labor supply behavior. Again, here the identifying assumption is that controlling for age- and year-fixed effects as well as pre-treatment labor supply, Statement receipt is exogenous. We further invoke the assumption that after controlling for demographics and pre-treatment behavior, the interaction with exogenous Statement receipt allows for estimation of the Statement's effect within each subgroup.

In order to examine how workers respond to multiple doses of information, we estimate the extent to which workers who reduced their labor supply when they received their first statement changed their labor supply differentially after

they received their second statement.

Specifically, we determine whether an individual decreased his hours worked or earnings two periods ago: that is, between waves $w-2$ and $w-1$, where wave w is the current wave. We construct an additional variable, which is the interaction between this prior decrease and whether the respondent had received a Statement before $w-1$. Then, we compare the labor supply responses of these individuals who previously decreased labor supply and had received a Statement across one additional dimension: did they receive a second Statement between $w-1$ and w? If so, what was the marginal effect of having seen a new version of their Statement that will now report a lower projected retirement benefit? Here, we do not claim to have identified the *ceteris paribus* effect of having previously decreased labor supply on current labor supply behavior; instead, we use the variation in second Statement receipt to identify the effect of updated information based on this previous labor supply decrease by comparing otherwise similar individuals who either receive this second Statement or do not by the current period. The assumptions underlying this specification are almost identical to those for equation (2.1): the rollout of the second Statement is uncorrelated with cross-cohort secular variation in labor supply trends.

As a check on our results, we also examine the impact of the Statement on predicted respondent-predicted Social Security Wealth. The HRS asks respondents about what they think their Primary Insurance Amount is. Mastrobuoni (2011) shows that the Statement leads individuals to have a better understanding of their retirement wealth. But, our analysis is based on the presumption that knowing the level of benefits tells one little about the effect of labor supply changes on one's PIA. Using respondent-reported PIA expectation, we estimate

a model similar to the one we use to identify the effect of multiple statement receipts, except we use a dependent variable an indicator for whether a respondent reports a drop in his PIA from the last survey. If our assumption that the Statement gives recipients little information about how changes in hours worked will translate into Social Security Wealth, we should see little effect of the second statement on the likelihood a respondent reports reduced wealth.

2.6 Results

2.6.1 Effect of Statement Receipt on Hours Worked and Earnings

Baseline Estimates

The main results from estimation of equation (2.1) for the sample of men aged 40-61 are shown in Table 2.3. In the table, each column presents results from a separate regression, and all estimates are accompanied by standard errors that are two-way clustered at the year and birth year levels (Cameron et al. 2011). In the first column, we show estimates that include all demographic controls as well as age and year fixed effects. In the second column, we also control for pre-Statement labor supply. Although the first column does not show a statistically significant or sizable effect, in our preferred estimates in column (2), Statement receipt reduces the amount of hours worked by 197.6 hours. This is an 18.5% decline relative to the mean hours worked of 1065.3 shown in Table 2.2a. Thus, Statement receipt has a large, negative effect on hours worked, even if it does not

affect the timing of when people report being "retired" as shown in Mastrobuoni (2011).

Table 2.3
Effect of Statement Receipt on Annual Hours Worked, Linear Regression Results, 1992-2002

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Self-Reported Hours Worked per Year						
Ever Received Statement	-19.87	-197.6	-	-187.1	-109.8	-232.9	-
	[93.11]	[41.04]***	-	[49.82]***	[49.35]**	[46.13]***	-
Age Category X Statement							
40 to 44			296.7				
			[378.8]				
45 to 49			52.28				
			[185.3]				
50 to 54			-205.4				
			[39.47]***				
55 to 59			-296.4				
			[56.13]***				
60 to 61			-191.5				
			[97.38]**				
Less than High School X Statement				-			
				-			
High School X Statement				-28.21			
				[54.08]			
College X Statement				75.97			
				[76.73]			
More than College X Statement				-53.59			
				[75.01]			
Had a 2nd Job Before Statement Receipt					281.5		
					[73.85]***		
2nd Job X Statement					-419.3		
					[108.8]***		
Ever Received 2 Statements						-304.7	
						[117.8]***	
Pre-Statement Hours Worked Category X Statement							
1 to 9 per Week							797.2
							[94.52]***
10 to 19 per Week							163.2
							[112.2]
20 to 29 per Week							-33.68
							[78.78]
30 to 39 per Week							-81.61
							[124.3]
Exactly 40 per Week							-343.8
							[59.77]***
Over 40 per Week							-593.3
							[53.04]***
Age Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age Category Control	No	No	Yes	No	No	No	No
Pre-Statement Hour Category Controls	No	Yes	Yes	Yes	Yes	Yes	Yes
Only OAI Qualified	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-293.2	1.05e-08	407.7	9.79e-09	-4.63e-08	1.37e-08	1.52e-09
	[41.44]***	[0.00148]	[250.8]	[0.00185]	[0.00195]	[0.00180]	[0.00122]
Observations	14320	14320	14226	14320	14320	14320	14320
R-squared	0.059	0.478	0.478	0.478	0.463	0.482	0.525

Notes: Unit of observation is person-wave. Dependent variable is self-reported hours worked across all jobs in the reference year. Sample limited to under age 62 men fully insured for Old Age Insurance in 1991 (those with at least 40 Quarters of Coverage by 1992). All regressions control for marital status, education, race, and age and year fixed effects; standard errors in brackets are two-way clustered at year and birth-year levels, 1992-2002 (i.e. HRS waves 2-6). All specifications are unweighted OLS.

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

There is much reason to believe that the effects of Statement receipt will dif-

fer across age groups. In fact, if workers correctly understand the Statement information, younger workers should not react at all to the information, as their PIA will be highly sensitive to hours worked over the remainder of their careers. If anything, we would expect there to be a positive effect among younger workers who are worried that their current PIA is insufficient for their expected retirement plans. Older workers, however, are more likely to reduce their labor supply if the Statement provides information that their Social Security Wealth is high enough to fund their retirement. This is exactly the pattern we observe in Column (3) of Table 2.3, in which we allow the effect of the Statement receipt to vary by worker age. The estimates for workers in their 40s are positive, although they are not statistically different from zero at conventional levels. Workers aged 50-61, however, significantly reduce their labor supply when they receive a Statement. These results strongly suggest that workers of different ages respond differently to retirement information.

In columns (4) and (5), we examine whether there are heterogeneous responses by worker education level and by whether a worker has a second job before the first statement receipt. The latter is a relevant group on which to focus because those with second jobs may have much more flexibility in hours that those with one primary job. We find no strong evidence of heterogeneous treatment effects with respect to education, but we do see a much larger negative response amongst workers who have a second job. Workers with only one job also reduce their hours worked, but the size of the effect amongst those with another job is almost four times as large. Predictably, worker flexibility in the ability to adjust hours worked without leaving their primary job leads to larger treatment effects. In Column (6), we also show a large, negative average effect of the second Statement receipt as well as the first receipt.

Finally in Table 2.3, we estimate whether workers respond differentially to receiving a Social Security Statement according to their pre-receipt hours of work. The results, shown in Column (7), show a large amount of heterogeneity, with low-hours workers increasing their hours worked and high-hours workers reducing their hours worked. Among those who work between 1-9 hours per week, there is a massive increase in hours worked of 797 hours. If all of these workers worked 9 hours a week for 50 weeks, this effect translates into a 177% increase in hours worked (=797/450). There also is a positive and large effect amongst workers who worked between 10 and 19 hours per week, although the estimate is not statistically significantly different from zero. The rest of the hours groups have negative coefficients, but only those who work 40 or more hours exhibit large and statistically significant declines in labor supply. For workers who worked exactly 40 hours per week, they reduce hours worked by 343.8 hours, which is a 17.2% decline relative to the mean (=343.8/2000). Those working over 40 hours reduce labor supply even more. These results clearly demonstrate that there is significant heterogeneity in the response to information receipt across the distribution of hours worked. One explanation for these results is that low-hours workers increase labor supply due to receiving information about low projected PIA levels, and vice versa for high-hours workers.

The results in Table 2.3 include hours from all types of work. However, as the second job effects indicate, it may be hard to reduce hours in one's primary occupation without switching jobs. This is not true for the self-employed, for whom it typically is easier to make adjustments on the intensive margin. In Table 2.4, we repeat our analysis using only self-employed hours. Note that all workers are included in these regressions, but that only their reported self-employed hours are used as the dependent variable.

Table 2.4

Effect of Statement Receipt on Annual Self-Employment Hours Worked, Linear Regression Results, 1992-2002

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Self-Reported, Self-Employment Hours Worked per Year						
Ever Received Statement	14.47	-326.3		-242.9	14.20	-309.3	
	[42.97]	[77.19]***		[89.27]***	[13.28]	[79.17]***	
Age Category X Statement							
40 to 44			281.8				
			[228.8]				
45 to 49			-41.46				
			[398.5]				
50 to 54			-878.3				
			[359.1]**				
55 to 59			-196.8				
			[129.9]				
60 to 61			138.9				
			[94.06]				
Less than High School X Statement							
High School X Statement				-105.1			
				[34.23]***			
College X Statement				-94.86			
				[71.72]			
More than College X Statement				-175.5			
				[80.02]**			
Had a 2nd Job Before Statement Receipt					79.32		
					[29.46]***		
2nd Job X Statement					-116.0		
					[83.86]		
Ever Received 2 Statements						159.4	
						[197.7]	
Pre-Statement Hours Worked Category X Statement							
1 to 9 per Week							107.6
							[82.32]
10 to 19 per Week							-107.1
							[186.3]
20 to 29 per Week							-70.99
							[136.1]
30 to 39 per Week							-129.8
							[116.8]
Exactly 40 per Week							-706.5
							[171.6]***
Over 40 per Week							-2183
							[156.9]***
Age Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age Category Control	No	No	Yes	No	No	No	No
Pre-Statement Hour Category Controls	No	Yes	Yes	Yes	Yes	Yes	Yes
Only OAI Qualified	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-106.5	-5.48e-09	153.9	-6.85e-09	-2.242	-7.07e-09	6.80e-09
	[24.79]***	[0.0166]	[79.54]*	[0.00105]	[5.706]	[0.0150]	[0.00281]
Observations	14320	14320	14226	14320	14320	14320	14320
R-squared	0.01	0.438	0.453	0.439	0.45	0.440	0.612

Notes: Unit of observation is person-wave. Dependent variable is self-reported hours worked across all self-employment jobs in the reference year. Sample limited to under age 62 men fully insured for Old Age Insurance in 1991 (those with at least 40 Quarters of Coverage by 1992). All regressions control for marital status, education, race, and age and year fixed effects; standard errors in brackets are two-way clustered at year and birth-year levels, 1992-2002 (i.e. HRS waves 2-6). All specifications are unweighted OLS.

* Significant at 10% level

** Significant at 5% level

*** Significant at 1% level

The results, on the whole, are similar to those in Table 2.3, but with some important differences we highlight. First, the average effect now is sensitive to controlling for pre-treatment hours worked, which suggests there is much un-

observed heterogeneity across self-employed hours worked that it is important to account for. In Column (2), the average effect is a reduction of 326.3 hours, which is a 143% decline relative to the sample mean of 227.8 hours (Table 2.2a). This finding suggests that a large proportion of workers respond to the receipt of their Social Security Statement by no longer engaging in self-employed work. This does not mean they exit the labor force, however, since most self-employed hours come from workers with another, non-self-employed job.

While the pattern of age results is largely similar to those in Table 2.3, except for a positive estimate for 60-61 year olds, the results in Column (6) suggest that for self-employed workers only the first statement matters for self-employed hours. This likely is due, at least in part, to the fact that workers reduce self-employed hours dramatically upon first Statement receipt. When they receive the second Statement, there is less room to adjust self-employed hours because many workers have already reduced these hours to zero.

Finally, in Column (7), we show estimates by pre-Statement self-employment hours worked. They are consistent with many full-time self-employed workers leaving the labor force (or moving to non-self-employed jobs). Among workers with 40 hours of self-employed hours, self-employed hours work drops by 35% (706.5/2000), and there is a very large decline in hours amongst those with more than 40 self-employed hours that is consistent with these workers no longer working in self-employment.

While hours worked is our preferred measure of labor supply, since it is a direct measure of worker behavior, it also is informative to examine earnings changes related to Statement receipt. Earnings estimates are somewhat hard to interpret in this setting, as workers may be switching jobs with differ-

ent wage rates. It thus is not obvious how the hours effects will translate into earnings changes. We analyze the effect of Statement receipt on earnings in Table 2.5, which show estimates of equation (2.1) in which annual self-reported labor market earnings are used as the dependent variable. The earnings estimates are much noisier than the hours estimates in Table 2.3, but the signs and magnitudes of the estimates tell a very similar story about worker responses to Statement receipt. On average, earnings decline by about $570 per year, and as with hours worked there is a strong age pattern. For earnings, there is evidence that those with a college degree experience higher earnings as a result of Statement receipt. Furthermore, those with a 2nd job have much higher earnings post-receipt, on the order of a 28.6% increase relative to the pre-treatment mean earnings level. This is a curious result, as these workers also decrease hours worked significantly, which means they must be working in higher-wage occupations post statement receipt.

Robustness Checks

As discussed in Sections 4 and 5, we make several data and modeling assumptions that are embedded in our main estimates. In this section, we explore the sensitivity of our results to several of these core assumptions. First, we examine how robust our estimates are to the use of sampling weights. As discussed in Section 4, much of the research using HRS data does not use these sampling weights. In part this is due to the fact that weights are not available in all years, which significantly reduces the sample sizes available and introduces potential biases in the age pattern of the sample. Our main analysis uses the unweighted sample to avoid this problem, but it is important to assess whether this assump-

Table 2.5
Effect of Statement Receipt on Annual Self-Reported Earnings, Linear Regression Results, 1992-2002

	(1)	(2)	(3)	(4)	(5)	(6)
	Self-Reported Earnings from All Jobs per Year, 2000 Dollars					
Ever Received Statement	2077	-570.3		1235	-746.1	-689.5
	[1033]*	[1153]		[1602]	[1235]	[1264]
Age Category X Statement						
40 to 44			11057			
			[8074]			
45 to 49			1861			
			[4985]			
50 to 54			-1483			
			[2339]			
55 to 59			-1274			
			[946.2]			
60 to 62			-530.3			
			[1630]			
Less than High School X Statement						
High School X Statement				-1027		
				[1476]		
College X Statement				-7694		
				[4366]*		
More than College X Statement				-2525		
				[4899]		
Had a 2nd Job Last Interview					-6594	
					[3174]**	
2nd Job Last Interview X Statement					9960	
					[5836]*	
Ever Received 2 Statements						-1007
						[2140]
Age Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Age Category Control	No	No	Yes	No	No	No
Pre-Statement Hour Category Controls	No	Yes	Yes	Yes	Yes	Yes
Only OAI Qualified	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1822	4607	2244	2612	2408	4483
	[6419]	[3417]	[4283]	[3555]	[2004]	[3449]
Observations	13048	13048	12966	13048	13048	13048
R-squared	0.065	0.088	0.087	0.089	0.123	0.088

Notes: Unit of observation is person-wave. Dependent variable is self-reported earnings across all jobs in the reference year, price adjusted to 2000 dollars with the CPI-U-RS. Sample limited to under age 62 men fully insured for Old Age Insurance in 1991 (those with at least 40 Quarters of Coverage by 1992). All regressions control for marital status, education, race, and age and year fixed effects; standard errors in brackets are two-way clustered at year and birth-year levels, 1992-2002 (i.e. HRS waves 2-6). All specifications are unweighted OLS.

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

tion is driving our results. Appendix Tables 2.3 through 2.5 contain these results, akin to the analyses in Tables 2.3 through 2.5.[6] We use the 1994 sampling

[6] Appendix Tables 2.2a and 2.2b contain descriptive statistics from our weighted sample.

weights, which restrict us to the 1931-1941 birth cohorts. We therefore no longer can examine effects among workers under 50.

The results in Appendix Table 2.3 match those in Table 2.3 closely. They are somewhat larger in absolute value, but that is to be expected since the younger workers with positive responses to the Statement now are excluded from the regressions. For self-employed hours, shown in Appendix Table 2.4, the average effect is now close to zero and is not statistically significant. However, the age patterns and the patterns across the distribution of pre-treatment self-employed hours worked are very similar to those in Table 2.4. For self-reported earnings, shown in Appendix Table 2.5, the results also are similar to the baseline estimates. While there now is stronger evidence of a declining age effect and the negative estimate for receiving a second statement now is larger in absolute value and statistically significantly different from zero at the 5% level, the qualitative results and conclusions are very similar across the two tables. Overall, we see little evidence that our decision to use the larger, unweighted sample influenced the conclusions one can draw from our results.

As discussed in Section 4, we use self-reported earnings data in our main analysis because the administrative earnings data are only available for people who remain in the sample to one of the three "match years" in the HRS. However, administrative earnings data have clear benefits over self-reported data, and so in Appendix Table 2.6 we assess the robustness of our results to using earnings data from the matched SSA earnings files. These estimates are weighted by the 1994 HRS person-level weights, combined with the estimated inverse predicted probability of being in the SSA-matched sample as a function of respondent observables in 2004 that we estimate using a logit model. The

resulting estimates are quite imprecise. Aside from the positive but not statistically significant average estimate in Column (1), the results are on the whole qualitatively similar to those in Table 2.5. There is little evidence to suggest that our use of self-reported earnings is driving our main earnings results.

2.6.2 The Effect of Multiple Statement receipt on Dynamic Labor Supply

We now turn to our analysis of how workers responded to receipt of multiple rounds of information that allowed them to update their knowledge of their Social Security wealth after their response to the first Statement receipt. Table 2.6 shows estimates of equation (2.2).[7] The main coefficient of interest here is the estimate on *Decreased Hours X 2nd Statement Between w-1 and w*.[8] This coefficient shows how workers who decreased their hours worked between two survey waves ago and the prior wave and who received a second Statement between the prior and current wave changed their labor supply relative to workers with the same pattern of lagged hours changes but who did not receive a second Statement.[9] The thought experiment underlying this regression is to compare two workers who reduced their labor supply due to receiving the first Statement but only one of whom received the second Statement. If the reduction in hours worked was due to a mis-interpretation of the information given in the State-

[7]Note that the sample sizes have declined because in order to measure lagged labor supply responses we have to start our analysis sample at wave 3.

[8]Although the estimates presented correspond to any decrease in labor supply, we have also used various minimum thresholds of decrease, such as 200, 300 or 400 hours. The estimates and their statistical significance remain unchanged.

[9]Note that very few workers have identical labor supply across the two surveys. Thus, all changes among those who reduce their labor supply are relative to workers who increase their labor supply in Table 2.6.

ment, then workers who had reduced their labor supply when they received the first Statement should increase their labor supply when they receive the second one.

Table 2.6
Effect of Statement Receipt on Annual Hours Worked, By Changes in Labor Supply in Previous Waves, Linear Regression Results, 1992-2002

	(1)	(2)
	Self-Reported Hours Worked per Year	
Ever Received Statement	-47.84	-45.12
	[69.19]	[69.32]
Ever Received 2 Statements	-518.7	-526.3
	[194.5]***	[224.2]**
Received a Statement by w-1	104.2	140.7
	[99.33]	[89.43]
Decreased Hours between w-2 and w-1	-235.2	
	[113.8]**	
Decreased Hours X Statement by w-1	-14.24	
	[224.4]	
Decreased Hours X 2nd Statement Between w-1 and w	268.9	
	[221.1]	
Decreased Earnings between w-1 and w-2		-9.756
		[47.32]
Decreased Earnings X Statement by w-1		-111.8
		[79.33]
Decreased Earnings X 2nd Statement Between w-1 and w		277.8
		[131.1]**
Age Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Constant	-567.5	-606.2
	[163.7]***	[158.6]***
Observations	10387	10387
R-squared	0.057	0.053

Notes: Unit of observation is person-wave. Dependent variable is self-reported hours worked across all jobs in the reference year. Sample limited to under age 62 men fully insured for Old Age Insurance in 1991 (those with at least 40 Quarters of Coverage by 1992). All regressions control for marital status, education, race, and age and year fixed effects; standard errors in brackets are two-way clustered at year and birth-year levels, 1992-2002 (i.e. HRS waves 2-6). All specifications are unweighted OLS.

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

The results in Table 2.6 are consistent with this story. Among those who decreased their hours between $w-2$ and $w-1$, but who did not recently receive a second Statement they continue to reduce their hours worked by 235 hours per year. However, if such workers received a second Statement, this effect goes to zero. While the coefficient on *Decreased Hours X 2nd Statement Between w-1 and w* is not statistically significant at even the 10% level, the magnitude of the coefficient is highly suggestive that the updated information from the second Statement led those who had previously reduced their labor supply to increase it again. That those who do not receive the second Statement continue to reduce their labor supply suggests we are not just picking up mean reversion. Rather, we interpret this as evidence that a set of workers misunderstood the information on the Statement to be accumulated (rather than projected) wealth and therefore reduced their labor supply. Only when they receive the updated information do they reverse this labor supply decline, and the magnitude of the coefficient is consistent with a complete reversal of the previous decline.

The estimate for earnings in Column (2) is more precise than for hours and points to the same conclusion. For those with decreased earnings between $w-2$ and $w-1$, those who receive a Statement prior to the current survey wave increase their earnings significantly. The estimated earnings effect is \$277.8, and it is statistically significantly different from zero at the 5% level. This evidence is consistent with a set of workers responding to the information on the Statement incorrectly due to a mis-interpretation of the information. Only when this information is updated can they see their mistake, and they respond by increasing their labor supply. At least for this set of workers, the misleading manner of the Social Security information likely made them worse off than if they had not been given this information. This is particularly true because of the negative

utility effects of labor market re-entry among older American that prior work has estimated (Rust and Phelan 1997).

While the results in Table 2.6 are highly suggestive of worker "mistakes" from misinterpretation of the Statement information, it is possible these workers knew what they were doing and we are picking up planned intertemporal changes in labor supply that happen to be correlated with Statement rollouts. If so, the labor supply changes we analyze should show up in respondent-reported expected PIA. That is, if workers reduced their labor supply in response to the Statement knowing full well it would reduce their Social Security Wealth, we should observe reported PIAs declining.

We explore this question directly in Table 2.7. Here, we use all workers who report an expected PIA as well as workers who report an accrual rate of at least 1%[10] to focus on those whose Social Security benefits are strongly tied to their continued labor force participation. For workers with an accrual rate of at least 1%, we can be sure that their Social Security wealth will decline if they reduce their labor supply. The dependent variable in this table is an indicator for reporting that one's expected PIA declined between this survey and the prior survey wave. In Columns (1) and (3), there is no evidence that workers who decrease their labor supply believe this will reduce their PIA. This is direct evidence that even older workers do not have a firm grasp of the fact that reducing their hours will negatively influence their Social Security wealth.[11] These estimates support

[10]The accrual rate was calculated as the percentage difference between monthly benefits if an individual did not work at all between the present and the collection date or if they worked one additional year at the same earnings level. Hence, it is a measure of returns to working one more year at the same earnings level, consistent with Coile and Gruber (2001)'s approach to modeling retirement incentives.

[11]While Liebman and Luttmer (2012) find that about 57% of respondents to their survey report that having higher earnings will increase future benefits. However, this still leaves a large portion of workers who do not understand this incentive, and they are unable to ascertain whether

our contention that the changes in labor supply shown in Table 2.6 reflects responses to misleading information.

Table 2.7
Effect of Statement Receipt on Decrease in Expected PIA, Linear Probability Results, 1992-2002

	(1)	(2)	(3)	(4)
	Decreased Expected PIA from w-1 to w			
Decreased earnings from w-1 to w	0.017	0.040***	-0.002	0.061**
	[0.013]	[0.017]	[0.023]	[0.027]
Ever received Statement		0.049		0.089*
		[0.035]		[0.050]
Decreased earnings X received Statement		-0.027		-0.077***
		[0.024]		[0.028]
Age fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
PIA Accrual Rate at least 1%	No	No	Yes	Yes
Constant	0.003	-0.046	-0.029	-0.101*
	[0.017]	[0.046]	[0.025]	[0.061]
Observations	2046	2046	1171	1171
R-squared	0.014	0.015	0.019	0.020

Notes: Unit of observation is person-wave. Dependent variable is whether individual decreased expected PIA from last interview to current interview. Sample limited to under age 62 men fully insured for Old Age Insurance in 1991 (those with at least 40 Quarters of Coverage by 1992) who had a predicted PIA last interview and current interview and did not change expected retirement date between the two interviews. PIA Accrual Rate calculated as percentage change between PIA based on working one more year at current earnings level and PIA based on only earnings up until current year. All regressions control for marital status, education, race, and age and year fixed effects; standard errors in brackets are two-way clustered at year and birth-year levels, 1992-2002 (i.e. HRS waves 2-6). All specifications are unweighted OLS.

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

In Columns (2) and (4) of Table 2.7, we examine how the likelihood a respondent reports declines in expected PIA respond to Statement receipt. Interestingly, for those who have not received a statement, workers correctly report that reductions in their labor supply will reduce their PIA. However, having received the Statement eliminates this effect, especially for those individuals who will actually experience a decline in their projected PIA due to lower earnings. The central reason behind this finding is that workers interpret the Statement information as accumulated wealth, and so they do not believe that reducing labor supply will reduce their accumulated PIA.

workers have the correct beliefs about the magnitude of this slope.

On the whole, this evidence suggests that older workers mis-interpreted the information they were given. While there is some knowledge that reducing hours worked will lower one's PIA, the information in the Social Security Statement gave individuals the mistaken belief that their PIA would not change when they reduced their labor supply. As a result, many workers reduced their hours worked. When they received the updated Statement, however, they then increased their hours worked again. Our findings thus are consistent with workers being highly responsive to retirement wealth information. But this finding also highlights the need for this information to be transparent and easy to understand, or workers will respond to the information by making optimization errors that can lead them to being worse off.

2.6.3 The Elasticity of Labor Supply with Respect to Perceived Social Security Benefit

A core questions in the economic analysis of the Social Security system is how Social Security wealth or benefits affects labor supply. The prior literature has focused mostly on the effect of Social Security wealth on retirement decisions of older workers (e.g., Krueger and Pischke 1992; Samwick 1998; Gruber and Orszag 2000; Coile and Gruber 2001). The only prior paper of which we are aware that estimates how the labor supply of relatively younger workers responds to their perceived Social Security benefits is Liebman et al. (2009). They exploit five discontinuities in the Social Security benefits formula to identify how workers respond net-of-tax benefit incentives, finding an elasticity of hours worked of 0.691 and an earnings elasticity of 0.21. Our analysis differs from

theirs by exploiting an information shock about future benefits rather than a change in the Social Security benefits formula to which workers are exposed that explicitly altered work incentives.

The main difficulty in estimating the labor supply elasticity with respect to Social Security benefits is that these benefits are highly endogenous to underlying labor force attachment. To the extent that the rollout of the Social Security Statement was exogenous with respect to worker labor force attachment, which we believe is a plausible assumption, it can be used as an instrument for worker beliefs about Social Security benefits.[12]

We first estimate OLS estimates of the relationship between expected PIA (i.e. monthly Social Security benefit) and both earnings and hours worked. These estimates are shown in Table 2.8, and we estimate these models both with and without individual fixed effects. Our results indicate that, if anything, workers respond positively to expected PIA. Without the fixed effects, the estimated earnings elasticity is 0.58, while the hours elasticity is much smaller at 0.09. They both are statistically significantly different from zero at the 1% level. However, when we include worker fixed effects, these estimates become much smaller. In particular, there now is little evidence of an hours effect.

Even with the individual fixed effects, we might be concerned the expected PIA is endogenous. The endogeneity comes about because both changes in worker expectations and labor supply could be driven by unobserved factors. For example, a negative health shock could change current labor supply but

[12] Another way in which our estimates differ from prior work is to estimate labor supply effects of worker beliefs about their Social Security benefit rather than responses to actual benefits. To the extent these differ, the relevant measure of benefits governing worker behavior should be their beliefs, however, so we believe this is the more appropriate measure to use in such an analysis.

Table 2.8

Elasticity Estimates of Expected Monthly PIA on Labor Supply, Regression Results, 1992-2002

	(1)	(1)	(2)	(1)	(2)
	Participation	Ln(Earnings)		Ln(Hours Worked)	
Ln(Expected PIA)	0.012*	0.120***	0.081*	0.069***	-0.002
	[0.007]	[0.031]	[0.04677	[0.014]	[0.028]
Age FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Pre-Statement Hours Category	Yes	Yes	Yes	Yes	Yes
Individual FE	No	No	Yes	No	Yes
Obs	4632	3599	3599	3780	3780
R-squared	0.436	0.266	0.632	0.235	0.485

Notes: Unit of observation is person-wave. Dependent variable is log self-reported earnings or self-reported hours worked. Sample limited to under age 62 men fully insured for Old Age Insurance in 1991 (those with at least 40 Quarters of Coverage by 1992) who had a predicted PIA. All regressions control for marital status, education, race, hours worked before first Statement receipt, and age and year fixed effects; standard errors in brackets are two-way clustered at year and birth-year levels, 1992-2002 (i.e. HRS waves 2-6). All specifications are unweighted OLS.

* Significant at 10% level

** Significant at 5% level

*** Significant at 1% level

not expectations about one's future PIA. This would bias our estimates towards zero. In addition, any changes in the timing of retirement preferences should impact expected PIA changes but not hours or earnings changes, which again would bias our estimates toward zero.

The rollout of the statement plausibly overcomes these problems by providing a source of variation in expected PIA that is unrelated to unobserved factors that can influence retirement wealth expectations as well as labor supply. IV estimates of the effect of expected PIA on labor supply are shown in Table 2.9. We instrument expected PIA with an indicator for whether an individual has received a Statement and the interaction with pre-Statement PIA. Note that we we also estimate this model using individual fixed effects, but due to a weak first stage the results are less credible, although the resulting estimates are qual-

Table 2.9

Elasticity Estimates of Expected Monthly PIA on Labor Supply, IV Regression Results, 1994-2002

	IV, no Individual FE			IV, Individual FE	
	Participation	Ln(Hours Worked)	Ln(Earnings)	Ln(Hours Worked)	Ln(Earnings)
First Stage: Predicting Ln(Expected PIA)					
Received Statement	-2.37***	-2.41***	-3.02***	-0.92**	-0.99**
	[0.28]	[0.33]	[0.35]	[0.43]	[0.49]
Statement X Ln(Actual PIA)	0.35***	0.35***	0.44***	0.14**	0.15**
	[0.04]	[0.05]	[0.05]	[0.06]	[0.07]
Implied Breakeven PIA	873	975	956	911	768
Age FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Pre-Statement Hours Worked Controls	Yes	Yes	Yes	Yes	Yes
Pre-Statement PIA Controls	Yes	Yes	Yes	Yes	Yes
Individual FE	No	No	No	Yes	Yes
R-squared	0.27	0.25	0.27	0.08	0.07
Observations	4632	3780	3599	3780	3599
F stat	37.77	28.86	29.35	5.76	6.22
Second Stage					
Instrumented Ln(Expected PIA)	0.032	0.257*	0.778***	0.30	0.56
	[0.064]	[0.135]	[0.22]	[0.53]	[0.86]
Age FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Previous Hours Worked	Yes	Yes	Yes	Yes	Yes
Individual FE	No	No	No	Yes	Yes
R-squared	0.44	0.21	0.18	0.11	0.06
Observations	4632	3780	3599	3780	3582

Notes: Unit of observation is person-wave. Dependent variable is log self-reported earnings or self-reported hours worked. Sample limited to under age 62 men fully insured for Old Age Insurance in 1991 (those with at least 40 Quarters of Coverage by 1992) who provided a prediction for their PIA in the HRS, starting in 1994 (i.e. HRS wave 2). All regressions control for marital status, education, race, and age and year fixed effects; 1994-2002 (i.e. HRS waves 2-6). Actual PIA calculated from matched SSA Summary Earnings File. All specifications are unweighted IV 2SLS.

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

itatively similar. The first stages shown in Table 2.9 are strong, with F-statistics between 28 and 38. As expected, and consistent with prior research workers' beliefs about their Social Security benefits are strongly affected by the Statement

(Mastrobuoni 2011). We provide instrumental variable analysis of not only intensive margin labor supply (log hours worked and log earnings), but also of the extensive margin participation decision.

The IV estimates show a strong, positive effect of expected PIA on the intensive labor supply of older workers. The participation elasticity still has a positive elasticity, but it loses its statistical significance. The hours elasticity is 0.26 and the earnings elasticity is 0.78. The former is statistically significantly from zero only at the 10% level, but the latter is statistically significantly different from zero at over the 1% level. In short, increases in worker beliefs about their Social Security benefits driven by receipt of the Statement increase their labor supply. Table 2.10 breaks down these IV estimates by age group. The clear implication is that the prior positive elasticity estimates are driven by those within 6 years of the early retirement age, thus supporting the notion that Social Security increases earnings and hours worked amongst older workers who are not quite at the early claiming age.

2.7 Conclusion

This paper examines how older workers respond to information they receive about their retirement benefits from the Social Security Statement. We exploit the rollout of the Statement to different birth cohorts and different years that we argue was uncorrelated with the underlying labor force attachment and retirement preferences of each cohort. One of our main contributions is to examine labor supply responses that include both the intensive and extensive margins, and we find that older workers' labor supply is highly responsive to receiv-

ing information about future Social Security benefits. Statement receipt leads to a reduction of 198 hours worked, on average. However, our estimates point to significant heterogeneity in this response. Workers age 50-61 reduce hours worked, and there is some evidence that workers aged 40-49 increase hours worked. Workers with a second job are also highly responsive. The is much heterogeneity across the distribution of pre-treatment hours worked as well, with low-hours workers increasing their labor supply post-treatment and high-hours workers significantly reducing their labor supply in response to receiving a Statement. We show these effects are evident for self-employed hours worked and, for the most part, show up in earnings.

In the second part of our analysis, we explore the extent to which the information on the Statement may have led some workers to mistakenly reduce their labor supply. This would happen if workers thought the information they were receiving was accumulated rather than projected wealth. We find evidence that this is the case using the rollout of the second Statement workers received that allowed them to update their information. Among workers who reduced their hours worked in the prior period due to the first Statement receipt, they increased their labor supply when they received the second Statement but not if they did not receive it. This evidence suggests that once workers' information was updated, they corrected their mistakes and increased their labor supply. Our results highlight the importance of providing clear information to workers, as it is likely at least some people were left worse off from this misleading information.

Finally, we use the rollout of the Statement as an instrument for workers' beliefs about their expected PIA to estimate the labor supply and earnings elas-

ticities with respect to expected Social Security wealth levels. These are among the first estimates in the literature of this parameter, as the majority of prior work has focused on labor force participation effects only. We find that worker hours and earnings increase when their expected PIA increases, which suggests this information does not, on the whole, dis-incentivize them from working.

Taken together, our results suggest that information older workers have about their retirement benefit levels is an important driver of their labor supply. However, our estimates also suggest caution in providing such information, as unless it is accurate and clear to workers what the implicit incentives are in the information being shared, they could be induced to make optimization errors that leave them worse off. That workers are so responsive to information provides much scope for information-based policy interventions to help them make more informed labor supply decisions as they approach retirement. An important area for further research is how to provide this information in the most salient and accurate way possible to avoid the complications that we show arise when information is misleading.

CHAPTER 3

THE EFFECT OF DISABILITY-PROGRAM INCENTIVES ON THE LABOR SUPPLY OF SSDI BENEFICIARIES: AN ANALYSIS USING SSI AND SSDI PROGRAM INTERACTIONS

3.1 Introduction

A central question of the disability literature is the extent to which the benefit structures of Social Security Disability Insurance and Supplemental Security Program, the two federal disability programs, affect labor supply among current recipients. This question is not purely academic: the rapid rise in these programs' rolls in the past two decades, coupled with an almost complete lack of exit from these programs back into the labor force, has led to Congress and the Social Security Administration's interest in proposals to mitigate this rise or encourage labor force re-entry. One of the foremost policy changes is to alter the benefit reduction rate for SSDI recipients: currently, SSDI recipients keep their benefit until they earn above the Substantial Gainful Activity level (currently at $1,070 per month), but if they earn above that level, then their benefit is entirely withheld. One proposed change would be to instead reduce benefits by $1 for every $2 of earnings above the SGA level. Implementation of this change may increase work among SSDI beneficiaries, but it may also induce entry of otherwise non-recipient workers onto the now more generous SSDI program. In order to weigh this cost with the benefit of increased work, labor supply elasticities with respect to SSDI policy parameters must be estimated.

However, studies of the incentive effects of these programs have been hamstrung by a general lack of regional variation in SSDI, as well as difficulty in

identifying the eligible population. A recent research agenda attempting to predict the induced entry and labor supply effects of a change in work incentives has used variation in both the Substantial Gainful Activity level and local wages to construct an estimate of the real local SGA and use the considerable *de facto* variation in this variable to estimate induced entry (Maestas and Zamarro 2012). Additionally, there is a large randomized control trial in the field to test exactly this proposed intervention on the labor supply of SSDI beneficiaries: the Benefit Offset National Demonstration. Under contract from the Social Security Administration, researchers from Abt Associates, as well as Mathematica Policy Research and other subcontractors, have implemented a nationally representative trial, whereby SSDI beneficiaries at demonstration sites are randomly chosen to face this $1 for $2 benefit offset. Although ongoing, preliminary results are consistent with the results found in this paper: SSDI beneficiaries are not substantially more likely to work when offered this more generous offset (Gubits et al. 2013).

These results are also generally consistent with other low estimates found in the field (Gruber 2000, French and Song 2012, Maestas et al. 2013, Moore 2014), with the only dissenting estimates coming from a study of the Norwegian DI system (Kostol and Mogstag 2014). The lack of comparability of this estimate to the American disability insurance environment, and the health insurance environment in particular, most likely accounts for the greater responsiveness of Norwegian DI beneficiaries. However, the majority of the papers cited above identify these elasticities from overall acceptance versus rejection from SSDI or staying on the SSDI rolls versus leaving them. Although the variation exploited provides strong internal validity to these studies, the applicability of their estimates to changes in benefit reduction rates is less straightforward. Additionally,

these studies either implicitly or explicitly ignore other programs which these beneficiaries may be receiving benefits from and which may affect labor supply decisions of this population.

For example, Supplemental Security Income (SSI), the other federal disability program, differs from SSDI in two ways. First, there is a maximum federal benefit as opposed to a benefit based on one's previous earnings. Second, it is means tested, and is thereby primarily targeted toward the elderly or disabled poor. However, its disability determination process is the same as SSDI. Thus, the existence of SSI creates program interaction incentives that may affect the decision-making of current SSDI beneficiaries or potential SSDI applicants. However, most analyses of these programs have treated them separately, and although the demographics of the SSI population more closely resemble the welfare population than SSDI recipients (Daly and Burkhauser 2003), there is substantial overlap between these two programs for a given disabled individual or a household containing a disabled individual. For example, in 2011, about 30% of SSI recipients also received SSDI benefits, and about 17% of SSDI receipients also received SSI benefits. SSI recipients are required to apply for any other possible program benefits they may be eligible for, including SSDI, the benefits from which offset SSI dollar-for-dollar. Therefore, many disabled individuals not currently on SSI, in the absence of their SSDI benefit, would be receiving SSI benefits instead.

To address both the range of program incentives an SSDI beneficiary may face, as well as the potential effect of an intensive change in benefit reduction rates instead of an extensive change in whether an individual receives any benefits, this paper utilizes the regional and temporal variation in program incen-

tives that results from the interaction between SSDI and SSI. In effect, it exploits the complex program interactions to identify earnings' responsiveness to different policy parameters that are otherwise difficult to measure by observing only one program.

In particular, many states provide supplements for SSI benefits. Because SSI recipients are required to apply for SSDI benefits, which have a different benefit reduction rate than SSI, the budget constraints for a given SSDI benefit can vary widely across states. Further, there have been large changes in the SGA and in these state SSI supplements over time. The result is that for a group of SSI-eligible individuals with similar SSDI benefits, the implicit marginal tax rate can be vastly different along wide ranges of earnings.

This difference in implicit marginal tax rates creates different incentives to work for otherwise similar individuals currently on SSDI. In this paper, I construct measures of the returns to work and the variation in these returns due to similar SSDI beneficiaries facing the 50% benefit reduction rate of SSI versus the SSDI budget constraint. Using these measures, I then test the responsiveness of current disability recipients' labor supply to implicit marginal tax rates with Survey of Income and Program Participation panels matched to Social Security administrative earnings records. Broadly consistent across reduced-form, simple structural, and maximum likelihood kinked budget constraint estimation, these elasticities are general lower than previous estimates in the literature. They range from -0.14 to -0.36 for participation, and -0.37 to -0.64 for earnings. One explanation for these lower estimates relative to the literature is the source of variation: otherwise similar SSDI beneficiaries facing a 50% benefit reduction rate. This variation stands in contrast to the more widely used variation in the

literature: facing outright acceptance or rejection of SSDI benefits. However, it is this variation, a 50% benefit reduction rate, that is of direct relevance to the proposed policy change.

This paper is thus the first to provide labor supply estimates for US disability insurance beneficiaries based on changes in the disability benefit reduction rate, as opposed to shifts in other program parameters. Additionally, although the Benefit Offset National Demonstration is currently in the process of implementing a randomized control trial to experimentally estimate similar elasticities, the analysis in this paper has the advantage of occurring in an existing, naturalistic setting, as opposed to BOND's combination of a program shift with a large information intervention about benefits. Also, this analysis specifically exploits the interactions between SSI and SSDI, allowing for a full understanding of the marginal incentives facing many SSDI beneficiaries, while BOND and other previous work on the topic largely ignores or merely controls for SSI receipt, assuming an independent effect of this other program on work behavior.

The rest of the paper is structured as follows: section 2 describes SSDI, SSI, and the sources of variation in their interaction; section 3 describes the Survey of Income and Program Participation panels; section 4 presents the identification strategy and results; section 5 concludes.

3.2 SSDI, SSI, and Their Interaction

3.2.1 Social Security Disability Insurance

Social Security Disability Insurance is the disability social insurance program within the Old Age, Survivors, and Disabled Insurance social insurance - generally referred to as Social Security - and provides earnings replacement for working-age adults. As such, benefit determination follows many of the same rules as Social Security Old Age Insurance benefits. However, because SSDI is designed for working-age adults, the eligibility requirements and benefit determination differ depending on age; for instance, while retirement benefits are based on 35 years of highest earnings, SSDI benefits are based on between 2 and 35 years of earnings, depending on age at time of disability eligibility.

To qualify for SSDI benefits, a potential beneficiary must be both medically eligible and satisfy SSDI's recent-work requirement. The medical eligibility is based on both the nature and severity of the impairment, as well as earnings capacity. If applicants' conditions are not in the Listings of Impairments, then their work capacity is evaluated. In order to be eligible, they must be unable to earn above a Substantial Gainful Activity level, at $1,010 per month for non-blind individuals in 2012. This SGA level has been indexed to average wage growth since 2001; prior to 2001 it was increased on an ad hoc basis.

The second requirement for eligibility, the recent-work requirement, is age dependent. For example, a 20-year-old applicant must have earned 6 Quarters of Coverage in the most recent 3 years (12 quarters), while a 50-year-old applicant needs to have earned 20 Quarters of Coverage in the most recent 10 years

(40 quarters). In 2011, a Quarter of Coverage was awarded for each whole multiple of $1,120 of earnings, with up to 4 QCs awarded per year.

Since SSDI is a social insurance program, a potential program participant's benefit level is calculated using previous earnings, or how much was paid into the program during his or her lifetime. SSDI follows the same calculation process as Old Age Insurance, first determining an Average Indexed Monthly Earnings (AIME) based on a given number of computation years, which is then translated into a monthly benefit through the progressive Primary Insurance Amount (PIA) schedule. Of particular note is that individuals generally face different benefit levels, derived from their earnings history, and the parameters in the AIME and PIA calculation are indexed to national average wage growth in the US, and therefore these benefits for successive cohorts tends to increase faster than price growth.

Once a future beneficiary applies and goes through the up-to-five stage determination and appeals process, is accepted and starts receiving benefits, she is on the SSDI rolls. Her benefit is then indexed to price inflation, and she enters a Trial Work Period, where she will receive her full benefits regardless of earnings. However, in the event she earns more than a certain threshold amount, $720 per month in 2012[1] for 9 months out of a rolling 5 year window, she exits the Trial Work Period and enters an Extended Period of Eligibility. During the EPE, the beneficiary continues to receive her monthly benefit as long as her earnings are below the SGA level. She receives no benefits in the months her earnings are above the SGA. However, during the three-year EPE, if her earnings fall back below SGA, she will automatically start receiving here monthly benefit again.

[1]Note that this value is less than the Substantial Gainful Activity level; additionally, it has been indexed to wage growth since 2001, but was increased only ad hoc before then. See Table 3.1 for the historical TWP level.

Table 3.1

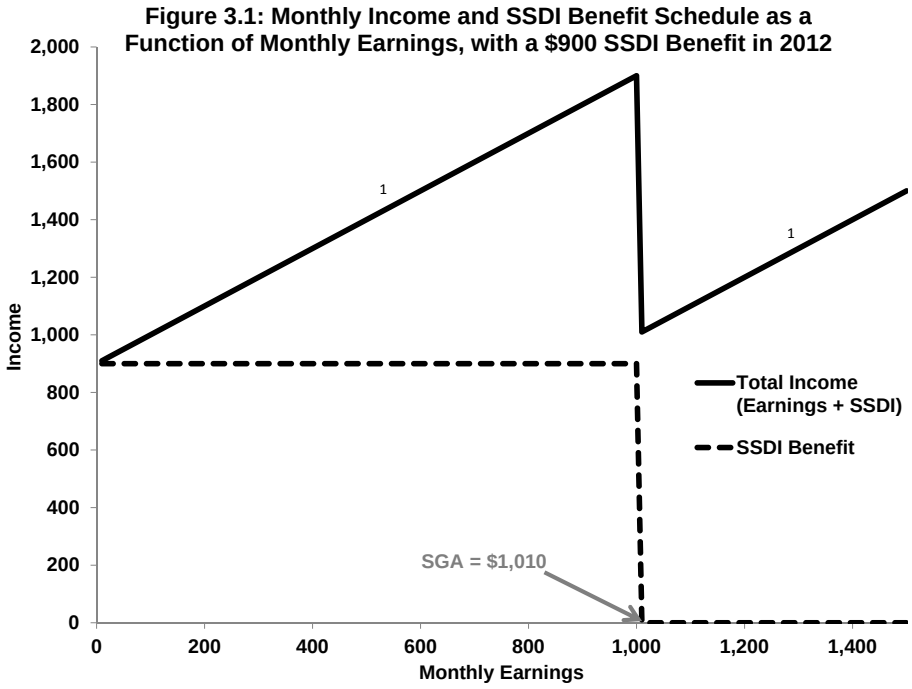
Historical Monthly Substantial Gainful Activity Level

Year	Blind SGA	Non-Blind SGA	Trial Work Period Threshold
1975	200	200	50
1976	230	230	50
1977	240	240	50
1978	334	260	50
1979	375	280	75
1980	417	300	75
1981	459	300	75
1982	500	300	75
1983	550	300	75
1984	580	300	75
1985	610	300	75
1986	650	300	75
1987	680	300	75
1988	700	300	75
1989	740	300	75
1990	780	500	200
1991	810	500	200
1992	850	500	200
1993	880	500	200
1994	930	500	200
1995	940	500	200
1996	960	500	200
1997	1000	500	200
1998	1050	500	200
1999	1110	700*	200
2000	1170	700	200
2001	1240	740	530
2002	1300	780	560
2003	1330	800	570
2004	1350	810	580
2005	1380	830	590
2006	1450	860	620
2007	1500	900	640
2008	1570	940	670
2009	1640	980	700
2010	1640	1000	720
2011	1640	1000	720
2012	1690	1010	720

* = in 1999, the SGA was 500 for the first half of the year. Source: SSA website.

Despite this complex structure, the bottom-line implication is that as long as a beneficiary earns under the SGA, she will receive her full monthly benefit, while if she earns above the SGA, she'll lose it entirely. As such, for every

additional dollar of earnings below the SGA, there's a zero implicit marginal tax rate in the SSDI system. However, exactly at the SGA, there's an earnings "cliff" representing a massive implicit marginal tax, and, depending on one's SSDI benefit relative to the SGA level or earnings, this cliff can represent large volatility in total monthly income. See Figure 3.1 for a schedule of earnings and its effect on benefit level and total income. only intensive margin labor supply (log hours worked and log earnings), but also of the extensive margin participation decision.



This cliff shifts only when the SGA itself shifts. Although the SGA has been approximately indexed to the National Average Wage Index since the early 2000s, before this period the SGA experienced sporadic and ad hoc adjustments. See Table 3.1 for a history of the SGA level.

The ad hoc nature of the SGA adjustments provides differing shifts between pairs of years before the 2000s, in particular the 1989-1990 and 1999-2000 year pairs.[2] These dramatic shifts of the SGA provide one source of variation in the returns to work embedded in the SSDI benefit structure and has been used on its own to arrive at estimates of induced entry onto the program depending on benefit levels (Maestas and Zamarro 2012). However, in this paper, I will use both these shifts in the SGA and differences in program parameters from the Supplemental Security Income program to provide variation in the benefit reduction rate faced by otherwise similar SSDI beneficiaries.

3.2.2 Supplemental Security Income

Since SSI's passage in 1972 and its implementation in 1974, the US federal government has provided a guaranteed income floor for disabled children, disabled adults, and to all persons once they reach age 65 via a means-tested negative income tax program. This level of the guarantee was designed to be enough to lift those not expected to work out of poverty with a maximum Federal Benefit Rate, indexed to price inflation and reduced accordingly as individuals receive more income, be it earned or unearned. Further, SSI recipients are required to apply for all other government programs for which they may be eligible, including SSDI. The medical eligibility standards and process are the same for SSDI and SSI applicants.

The maximum benefit for an individual in 2012 was $698. Benefits are reduced as income rises: unearned income, including SSDI benefits, reduces SSI

[2] Although currently, my access to the SIPP-SSA does not allow separate identification of blind SSDI recipients, the next version of the data will, allowing for another source of variation in marginal incentives facing SSDI beneficiaries.

benefits dollar-for-dollar after a $20 general income exclusion. For every $2 of earnings, SSI benefits fall by $1 after a $65 monthly exclusion.[3] In addition to these income tests, SSI has a strict assets test. Countable assets cannot exceed $2,000 for individuals or $3,000 for couples (these values are not indexed to inflation and were last adjusted in 1989). Some states provide supplements to the federal SSI benefit level of varying generosity. Of those states with additional benefits, these programs increase the maximum benefit but generally do not change the benefit reduction scheme.[4]

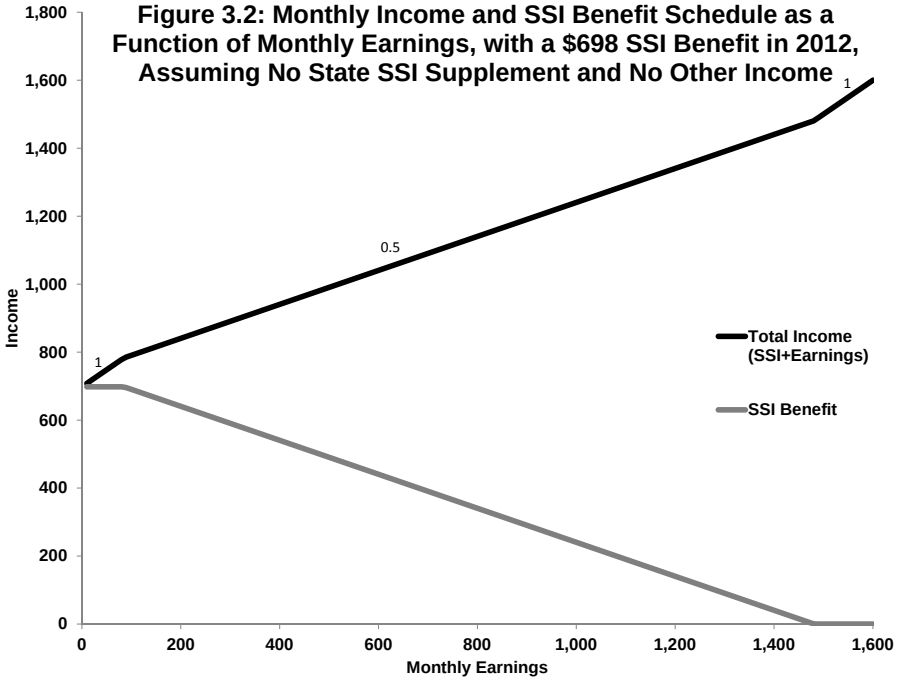
The SSI program also allows for those receiving SSI benefits to continue to do so even if they earn above the SGA level, as long as their SSI benefit is still positive according to the benefit reduction formula, and they continue to qualify for SSI under the medical disability and asset limit standards. As such, the schedules for SSI benefit and income are linear, as shown in Figure 3.2.

As can be seen in Figure 3.2, the first $65 of earnings are excluded under the earned income exclusion, then the next $20 is excluded with the general income exclusion (due to the assumption of no other income, earned or unearned). There is then a $0.50 reduction in benefits for every $1 of earnings, meaning that while the benefit falls smoothly until completely eliminated by earnings, pre-tax total income rises by $0.50 for every dollar of earnings until the SSI benefit is exhausted.

The SSI-disabled rolls have grown substantially over time, despite the real value of federal benefits remaining fixed. Since 1975, the federal SSI benefit

[3] This $65 monthly earnings offset has stayed fixed in nominal terms over the entire window of this study.

[4] As an example of a state that does change the benefit reduction scheme, in Wisconsin, the SSI State Supplement is constant up until the Federal SSI benefit drops to zero, at which point so does the supplement, thereby producing another small cliff. These exceptions are accounted for in the analyses below.



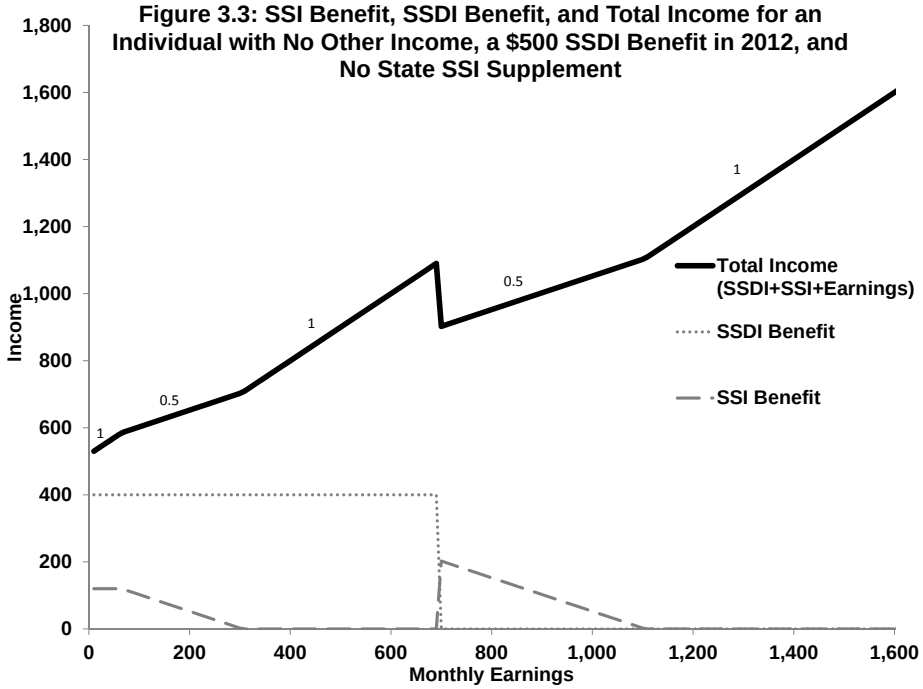
guarantee has increased each year based solely on the growth in the consumer price index (CPI-W) which, since 1975, has not grown as quickly as average wage earnings. The National Average Wage Index, the basis for calculation of SSDI benefits, has grown substantially faster than the CPI-W beginning in the mid-90s. Thus all succeeding cohorts of adults coming onto the SSI-disabled adults rolls since 1979 have received the same real value of benefits even though the average American worker's wage earnings have increased substantially since then. Further, succeeding cohorts of adults coming onto the SSDI rolls will experience increased disability benefits relative to SSI benefits (see Armour et al. (2011) for a discussion of this change's effect on disabled young adults).

In addition to this gradual change in the relative generosity of SSDI and SSI benefits, individuals in different states will face different SSI benefit levels, and

these SSI supplements also change over time when states opt to adjust them.

3.2.3 SSI-SSDI Interaction

Given this variation in SSDI and SSI policy parameters (SGA, SSI State Supplements, Wage vs. Price Growth), across time and states[5], different individuals can face vastly different implicit marginal tax rates if eligible for both SSI and SSDI, even if they have the same potential SSDI benefit. Figure 3.3 below illustrates these differences.



[5]There is also a different SGA level and different SSI benefits for blind disabled individuals; however, this subsample is very small relative to the overall size of the rolls and has not been increasing at a similar rate. Moreover, the data used in this analysis cannot distinguish between these two types of disabling conditions - blind and non-blind - and therefore assumes all individuals in the sample face the non-blind program parameters.

Because the SSI benefit is reduced by both unearned income (dollar for dollar) and earned income (fifty cents per dollar), the unearned SSDI benefit reduces SSI benefits. Additional work reduces the SSI benefit further, wherein the beneficiary faces a 50% benefit reduction rate (once they are past the $65 earnings offset, which has stayed fixed in nominal terms). When the SSI benefit is reduced to zero, the beneficiary faces no benefit reduction rate until the SGA earnings cliff. Once an individual earns above the SGA and loses her SSDI benefit, her SSI benefit is no longer offset by her SSDI benefit and thus rises, reducing the magnitude of the SSDI-based income cliff and returning the beneficiary to a 50% benefit reduction regime. This regime lasts until the beneficiary earns up to the point where the SSI benefit is reduced to zero due entirely to earnings, wherein the individual has zero overall disability benefits and no longer faces any benefit reduction rates.

Of note is the interval of earnings wherein earnings and the SSDI benefit have reduced the SSI benefit to zero: the benefit reduction rate in this interval is zero, while the benefit reduction rate for earnings on either side is 50%. It is this rate difference that allows for identification of how work among the disabled population differs according by implicit marginal tax rates. This rate difference arises from the interaction of SSI and SSDI parameters, specifically the SGA level, the relative value of federal SSI and SSDI benefits, and the level of the SSI state supplement.[6] The last parameter can vary over time, across family types, and especially across states. See Table 3.2 for a list of the SSI state supplements for non-blind individuals in 1988 and 2002 and the real difference between them. Since most states' SSI supplements have stayed constant or near-

[6]Additionally, the real value of the $65 SSI earnings offset has declined over time, which increases the width of the first 50% benefit reduction regime.

Table 3.2

SSI State Supplements for Single Individuals, in Current Dollars, and Real % Change, 1988 and 2002

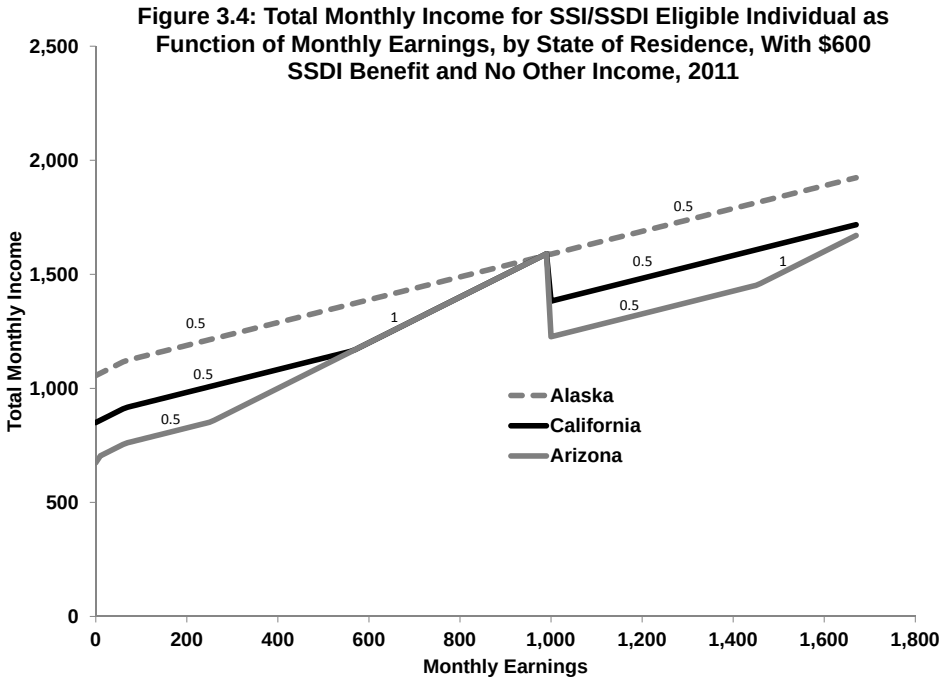
	Nominal State Supplement		Real % Change
	1988	2002	
Alabama	0	0	n/a
Alaska	305	362	-18.8%
Arizona	0	0	n/a
Arkansas	0	0	n/a
California	221	206.67	-36.0%
Colorado	58	37	-56.3%
Connecticut	393	202	-64.8%
Delaware	0	0	n/a
District of Columbia	15	0	-100.0%
Florida	0	0	n/a
Georgia	0	0	n/a
Hawaii	5	4.9	-32.9%
Idaho	73	52	-51.3%
Illinois	36	40	-24.0%
Indiana	0	0	n/a
Iowa	0	0	n/a
Kansas	0	0	n/a
Kentucky	0	0	n/a
Louisiana	0	0	n/a
Maine	10	10	-31.6%
Maryland	0	0	n/a
Massachusetts	129	121	-35.8%
Michigan	30	14	-68.1%
Minnesota	35	81	58.4%
Mississippi	0	0	n/a
Missouri	0	0	n/a
Montana	0	0	n/a
Nebraska	43	8	-87.3%
Nevada	36	44	-16.4%
New Hampshire	27	27	-31.6%
New Jersey	31	31.25	-31.0%
New Mexico	0	0	n/a
New York	72	87	-17.3%
North Carolina	0	0	n/a
North Dakota	0	0	n/a
Ohio	0	0	n/a
Oklahoma	64	53	-43.3%
Oregon	2	2	-31.6%
Pennsylvania	32	27.4	-41.4%
Rhode Island	59	64.35	-25.4%
South Carolina	0	0	n/a
South Dakota	15	15	-31.6%
Tennessee	0	0	n/a
Texas	0	0	n/a
Utah	9	0	-100.0%
Vermont	58	59.04	-30.3%
Virginia	0	0	n/a
Washington	28	13	-68.2%
West Virginia	0	0	n/a
Wisconsin	103	83.78	-44.3%
Wyoming	20	9.9	-66.1%

Source: Urban Institute's TRIM3 Policy Parameters

constant in nominal terms,[7] there has been a decline in the real value of these benefits over time. However, from 1998 to 2002, there have been 198 nominal

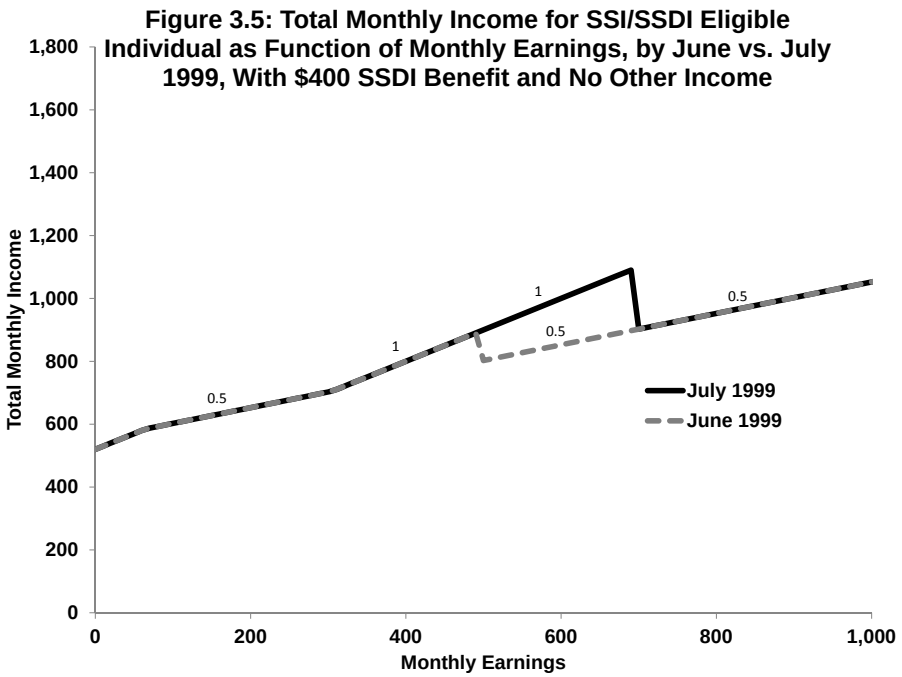
[7]The one exception is Minnesota, which increased their nominal benefit from 35% to 81% from 1988 to 2002

changes in state SSI supplements, with 61 of them over $10.



Because all of the aforementioned parameters have changed, sometimes dramatically, over the course of the past few decades, the incentives for otherwise similar individuals can differ dramatically. For example, Figure 3.4 shows the 2011 income schedules for three SSI and SSDI eligible individuals with the same monthly SSDI benefit of $600. One lives in Alaska (SSI state supplement of $362 in 2011), another in California (SSI state supplement of $156 in 2011), and a third in Arizona (no SSI state supplement).

As is apparent, the width of the zero-rate interval differs dramatically from state to state with otherwise similar individuals. In addition to a higher SSI

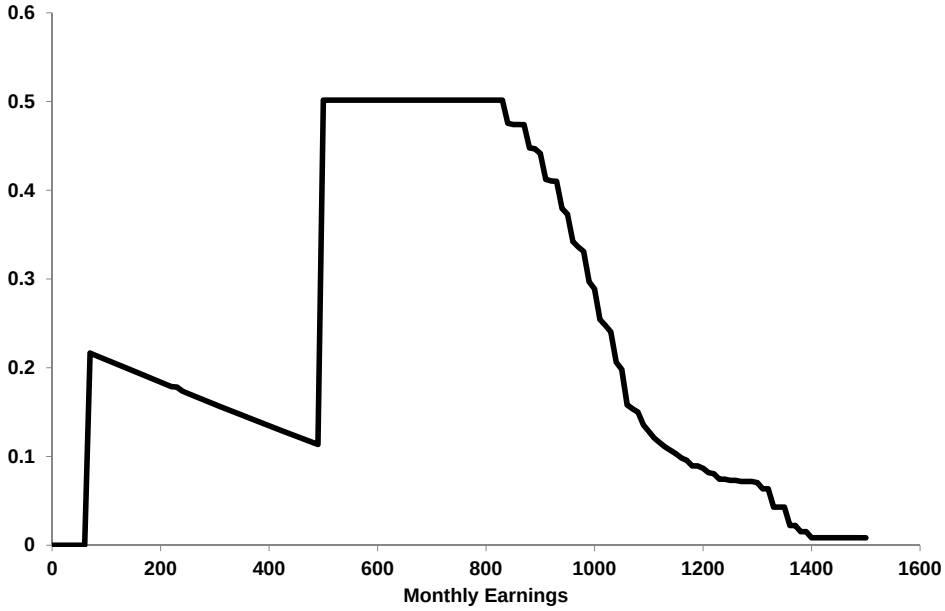


state supplement level (weakly) shifting the total income line upward,[8] thereby shrinking the zero-rate interval, a higher SGA level will directly increase the width of this interval by shifting the upper bound of the interval outward in the earnings space. Figure 3.5 shows this shift by displaying the income schedules of a given individual with a $400 SSDI benefit in June 1999 vs. July 1999, when the SGA increased from $500 to $700.

The zero-rate interval increases markedly with this ad hoc increase in the SGA in the middle of 1999. Figures 3.4 and 3.5 demonstrate how individuals with the same SSDI benefit can face vastly different marginal incentives depend-

[8] An individual's SSDI benefit could be high enough to completely offset her SSI benefit, so the total income line before the SGA would stay fixed if the SSI state supplement were not high enough. However, the post-SGA portion of the line is still strictly increasing in SSI state supplement.

Figure 3.6: Fraction Facing 50% Reduction Rate at each Potential Earnings Level, 1990-1999



ing on current SGA level and state of residence. It is through differences in SSI state supplements, the SGA, and the SSDI benefit itself due to benefit parameter changes, that creates this variation in the size of the zero-rate interval and the surrounding 50% benefit reduction rates, which in turn allows for identification of the effect of different marginal incentives on work behavior of those within in the program. Figure 3.6 shows the fraction of individuals in my preferred sample (SSDI beneficiaries who received SSI benefits at some point in my sample window) facing the 50% disability benefit reduction rate at each potential monthly earnings level.

3.3 Data

3.3.1 SIPP Synthetic Beta and Completed Data Files

To estimate the effect of facing these different benefit reduction regimes on SSDI beneficiaries' labor supply, I use Survey of Income and Program Participation (SIPP) panels matched to Social Security earnings and benefit administrative records. The SIPP is a panel-format survey, with 2- to 4-year panels of households. In this analysis, I use the panels beginning in 1990, 1991, 1992, 1993, 1996, 2001, and 2004. Panel participants are then matched to numerous Social Security administrative data: the Master Earnings File (with earnings and Quarters of Coverage information from 1951 to 2006), the Master Beneficiary Records, the Supplemental Security Records, and the Payment History Update System. Access to these administrative-matched SIPP panels is restricted for the purposes of confidentiality; to access the full SIPP-SSA matched files requires either a Census Research Data Center project or contact with a Census or SSA coauthor authorized to use these data on an approved project. However, a subset of the SIPP-SSA, the Gold Standard File, is available via the Census Synthetic Data Server as the SIPP Synthetic Beta. The SSB is designed to provide the benefits of these matched data while preserving the confidentiality of survey respondents - any researcher may apply for an account to use synthetic versions of the Gold Standard File, requiring only a feasibility review.

The Gold Standard File (GSF) is created by sifting out and standardizing comparable variables across the 1990 to 2004 SIPP panels. Then, these individuals are matched to their Social Security Number and then to their Summary Earnings Records and Detailed Earnings Records from the Master Earnings File,

followed by further matches to each of the other administrative data sets. However, at this stage, the GSF contains missing values. These values are imputed multiple times, resulting in four separate implicates, referred to as Completed Data Files of the original Gold Standard File.

Last, all variables, except spousal link, type of OASDI benefit, and gender, are synthesized, conditional on the values in a given Completed Data files. This synthesis is performed four times for each Completed Data file, resulting in a total of 16 implicates. See Abowd et al. (2006) for a thorough description of the SSB project. Outside researchers construct and run their analyses on these synthetic implicates and combine the results to produce single estimates. Once this has finished successfully, an internal Census researcher then runs this analysis on the four non-synthesized Completed Data Files. These results are then released according to the RDC project disclosure protocol.

All results presented here are the results from the Completed Data Files, with code created on the Census Synthetic Data Server, tested on the SSB, then run by an internal Census researcher on the confidential data, with the final results then released. Although the SIPP Synthetic Beta requires only a feasibility-based application process and an expedited disclosure process (in comparison to the RDC project disclosure process), the SIPP Synthetic Beta contains far fewer variables than the public SIPP. In particular, there is no specific information on disability other than the work-limiting question from the public SIPP.

3.3.2 Variable and Sample Construction

To estimate the labor supply elasticities using the variation described above, I limit my analysis to SSDI beneficiaries who started being paid their benefits prior to the current calendar year. My sample window stretches from 1988 to 2002, since this period has the greatest variation in SGA and state supplements. I further limit the analysis to those under 62 to prevent interactions with Social Security retirement benefits. I include only those individuals who are unmarried or married with a non-SSDI/SSI-beneficiary spouse. Approximately 4% of the sample is dropped with this latter exclusion; although there is potentially exploitable variation between SSI/SSDI couples vs. individuals, modeling the joint labor supply decisions of these spouses is distinct from the individual labor supply decision and is thus beyond the scope of this analysis, especially given the rarity of these couples.

My last restriction concerns SSI eligibility: not all SSDI beneficiaries are entitled to SSI benefits due to its asset test or because their SSDI benefit offsets the SSI benefit available in their state completely. Fortunately, my dataset contains a measure of non-housing wealth, which although fixed in time corresponding to the respondent's answer in a particular SIPP topical module, gives a sense of how close to passing an asset test an individual is. Almost all analyses below limit their sample to one of four subsamples: those who received SSI at any point in our sample as determined by SSI administrative records, those with under $2,000 in non-housing wealth (the asset test for individuals over this time period), those with under $10,000 in non-housing wealth (including those "near-eligible" for SSI, and those with non-negative non-housing wealth under $10,000 (excluding those who may have more exotic financial holdings

unlikely to be eligible for SSI). The results are largely consistent across these subsamples, suggesting that although the elasticities estimated in this analysis are for poorer SSDI beneficiaries, they most likely apply to a broader range of SSDI beneficiaries than just those SSI eligible or near-eligible.

My dependent variables are either annual earnings or annual labor force participation, which is defined as having any earnings in a year. Both of these variables are constructed using SSA administrative earnings. Additionally, monthly self-reported hours worked and monthly self-reported earnings from 1990 to 2002 are accessible in the most recent 5.1 version of the SIPP Synthetic Beta. However, these hours variables correspond to months in which SIPP respondents are currently in a survey, and therefore last for between 2 to 4 years depending on which panel the individual is in and have no observations for 1995 or 2000. Moreover, these monthly self-reported variables do not sit astride a large source of variation in this analysis: the ad hoc shifts in the SGA levels in 1990 and 2000.

Next, for each individual I must determine their SSDI benefit, their potential SSI benefit, any potential AFDC/TANF and Food Stamp benefits available to them, and the taxes they may need to pay. Although the Master Beneficiary Record (MBR) and Payment History Update System (PHUS)[9] both have information on the initial payments due to SSDI beneficiaries, these initial payments may not be representative of monthly benefits due to back-pay. To determine the SSDI benefit an individual would receive on a recurring basis, I use the admin-

[9]The MBR measures what an individual is determined to be entitled to and is retroactively updated anytime a new OASDI determination is made, while the PHUS measures when an individual is actually paid out his or her benefits. As such they can differ dramatically, especially with regard to individuals who appeal SSDI rejections. If they win their appeals, then their eligibility date and benefit will correspond to their original application's onset date, although benefits will not be paid out to them until much later.

istrative earnings records to reconstruct each SSDI beneficiary's SSDI Primary Insurance Amount at the time they were considered eligible for the program, with this eligibility date determined by the MBR. However, I then assign the beginning of their SSDI benefit receipt to the year after they receive their first SSDI payment, as determined by the PHUS. Hence, these individuals have already received any SSDI back-payments and are now receiving the monthly benefit based on their earnings up to their date of eligibility.

I calculate potential maximum SSI benefits as the federal maximum, referred to as the Federal Benefit Rate, in a given year, in addition to the SSI state supplement in that year. Both the SSDI and SSI benefits are reduced according to federal and state laws in each work scenario modeled in the analysis below.

Welfare benefits (AFDC/TANF) are modeled according to the same state rules used by Meyer and Rosenbaum (2001) as well as the program rules in the Urban Institutes TRIM3 model, taking into account year, family structure, state of residence, earnings, and unearned income. Food Stamps benefits are similarly modeled. I input these same income, location, and family structure variables into NBER's Taxsim program to calculate federal, state, and payroll tax burdens and rates over this time period. Since the real value of these benefits is of more relevance than their nominal amount, all income sources are adjusted for general price inflation using the CPI-U-RS as well as regional variation with the Cost-of-Living Geographic Pricing Cost Index used by Medicare to account for state-level cost-of-living differences. Tables 3.3a and 3.3b provide descriptive statistics for all the dependent and independent variables used in the analyses below.

Table 3.3a

Descriptive Statistics

	Counts
Person-Years	397,615
Unique People	29,963
	Mean
Dependent Variables	**(SD)**
ln(earnings)	9.40
	(1.57)
participation	0.68
	(0.47)
Independent Variables	
Expected in 50	0.16
	(0.37)
Likelihood in 50	0.39
	(0.19)
Age	42.02
	(11.56)
Male	0.54
	(0.50)
Married	0.45
	(0.50)
Spousal Income if Married	17,466.52
	(22,252.11)
Monthly Variables	
Wage	10.96
	(1.46)
Hours Worked	61.24
	(87.98)

Benefit Levels	**# Positive**	**Mean if Positive (SD if Positive)**
SSDI	392,720	903.17
		(518.97)
SSI	125,881	249.55
		(180.74)
SNAP	225,666	158.21
		(91.27)
AFDC/TANF	34,662	280.24
		(178.93)

Source: SIPP-SSA, unit of observation is person-year or person-wolf where appropriate, 1988-2002. Income measures in 2002 dollars with CPI-U-RS.

3.4 Analysis

In contrast to prior papers estimating labor supply elasticities, this analysis uses three distinct techniques: a basic reduced form approach using differing benefit

Table 3.3b

Demographics Characteristics	
Education	
No High School	76,696
High School	133,992
Some College	110,371
College	48,938
Graduate	27,618
Industry	
Manufacturing	49,187
Wholesale/retail	44,759
Public services	121,711
Agriculture, Mining, Construction, and Other	42,300
Occupation	
Managerial and Professional	66,646
Sales and Support	69,258
Other	121,540
Race	
White	314,815
Black	60,708
Other	22,092
Hispanic	
No	358,683
Yes	38,932
Wealth Category	
Negative	43,122
Exactly 0	53,939
0 to 5,000	38,089
5,000 to 10,000	35,634

Source: SIPP-SSA, unit of observation is person-year, 1988-2002

reduction rates from expected earnings, a more complex reduced form model adapted from Meyer and Rosenbaum (2001), and a structural maximum likelihood estimation adapted from Friedberg (2000)'s analysis of the Social Security

retirement earnings test. Together, these distinct methodologies allow for additional checks on the robustness of the estimates.

3.4.1 Basic Reduced Form

This technique tests the following question: what is the labor supply of those individuals more likely to face a 50% benefit reduction rate due to the state and year in which they live, all things equal. This greater likelihood is calculated in two ways: first, would an individual face the 50% benefit reduction rate given average earnings among work-limited individuals of the same gender, marital status, and family structure; or second, how likely is an individual to face a 50% benefit reduction rate, given the distribution of earnings of individuals of the same gender, marital status, and family structure. The former is therefore a binary variable, while the latter can take on any value between 0 and 1.

To calculate these measures I follow Meyer and Rosenbaum (2001) in generating an earnings distribution based on a joint annual hours-worked - wage distribution from the March Current Population Survey. However, I diverge from their analysis in that I restrict the sample from the March CPS to those who report a work-limiting health condition. Then I estimate the likelihood of their earning at or above 6 different annual hours worked points (100, 200, 500, 1000, 2000, 2500) and 10 different hourly wages (4, 5, 6, 7, 8, 10, 12, 15, 20, 25), given their gender, whether they were married, and whether they had any children. This distribution was estimated based on pooled samples from the 1988-1995 March CPS and the 1996-2002 March CPS separately. Assuming that this is the distribution of hours worked/wage offers available to a potential SSDI benefi-

ciary amounts to the assumption that these SSDI beneficiaries face employment options similar to the work-limited population more generally, and that such beneficiaries have access to no more information about their career prospects than a researcher.

I construct my sample according to the restrictions described in the above section, where each individual contributes one observation for every year that they have been receiving SSDI benefits after their first year of receipt up to age 62. With this sample and the distribution of earnings from the March CPS, I then calculate the first likelihood: whether a given SSDI beneficiary who is potentially eligible for SSI would face the 50% benefit reduction rate from the SSI benefit system if they earned at the average earnings level in their state and year. Additionally, I calculate the second likelihood: in what percentage of the earnings distribution does an individual face the 50% reduction rate. Regressing labor force participation or actual (log) annual earnings onto these likelihoods gives an estimate of the effect of facing a 50% disability benefit reduction rate on these labor supply components, following equation (1) below.

$$LS_{it} = \kappa + \alpha F(50\%BRR)_{it} + X'_{it}B + Y'_{it}\Gamma + Z'_{it}\Lambda + \epsilon_{it} \tag{3.1}$$

where LS_{it} is a labor supply decision, either participation or earnings. $F(50\%BRR)$ is a function indicating that either individual i in year t is expected to face a 50% benefit reduction rate on his or her disability benefits, or the likelihood of facing this rate. X_{it} is a vector of standard demographics, such as occupation, gender, marital status, having any children, and industry. Y_{it} is a vector of indicator variables for age, year, and state of residence, so the γ vector represents fixed effects for these variables. Last, Z_{it} is a vector composed

of the various income amounts when an individual i is not working in year t, including SSI and SSDI benefits, AFDC/TANF benefits, Food Stamps benefits, and spousal income if applicable. Cash benefits, SNAP benefits, and post-tax earnings are each allowed to have a different coefficient, indicating that they may have distinct effects on the labor supply decision.

These regressions results are included in Tables 3.4, 3.5, and 3.6,[10] wherein the controls in equation (3.1) are gradually introduced. In the first 5 specifications, the sample is limited to individuals who have at some point received SSI benefits, as determined by SSI administrative records. Although demographics and fixed effects do not substantially change the estimate for either earnings or participation, the inclusion of additional income sources greatly reduces these estimates, suggesting that a substantial component of facing a 50% disability benefit reduction rate derives from benefit income in the no-work scenario. Once these benefits are controlled for, the analysis produces participation elasticities on the order of -0.2 to -0.3, depending on which measure of facing the 50% rate is used: binary or likelihood.[11] These estimates are slightly lower than those found in the literature, although the confidence intervals overlap with such seminal estimates as Gruber (2000).

Table 3.5 presents earnings-level estimates, including those with no earnings. Although including non-workers is non-traditional in the labor supply elasticity estimation field, since many SSDI workers enter and exit the labor

[10] Additionally, Appendix Table 3.1 shows the impact on labor force participation at an annual earnings rate higher than twelve times the Substantial Gainful Activity level. These results are presented only in the appendix because an individual could earn many times the SGA in a year provided they keep enough months under the Trial Work Period threshold to prevent leaving the Trial Work Period.

[11] Although the coefficient on likelihood is higher than that of the binary variable, its average in the population is much higher as well, so when rescaled to represent a shift from no benefit reduction rate to a 50% rate, it produces comparable elasticity estimates as the binary variable, albeit slightly higher.

Table 3.4

Effect of Facing 50% Benefit Reduction Rate on Labor Force Participation, OLS Results

	Ever SSI				By Wealth Level
	(1)	(2)	(3)	(4)	(5)
Expected in 50	-0.246***	-0.195***	-0.236***	-0.091***	
	(0.005)	(0.007)	(0.009)	(0.015)	
Expected in 50 X Negative Wealth					-0.099***
					(0.038)
Expected in 50 X 0					-0.087***
					(0.027)
Expected in 50 X 0 to 5,000					-0.107**
					(0.046)
Expected in 50 X 5,000 to 10,000					-0.078**
					(0.039)
Implied Elasticity [95% Range]	-0.54	-0.43	-0.52	-0.20	
	[-0.56, -0.52]	[-0.46, -0.40]	[-0.56, -0.48]	[-0.27, -0.14]	
Demographics	No	Yes	Yes	Yes	Yes
Age, State, and Year Fixed Effects	No	No	Yes	Yes	Yes
Spousal Income	No	No	No	Yes	Yes
All Income When Not Working	No	No	No	Yes	Yes
R-squared	0.043	0.046	0.065	0.080	0.098
Observations	17719	17719	17719	17719	13072

Notes: OLS regression results from SIPP-SSA matched files. Dependent variable is SSA administrative earnings. Unit of observation is person-year. 1988-2002 sample window. Limited to those who received SSDI benefits at least one year ago. Demographics include education, occupation, industry, gender, and marital status. "Expected in 50" is a binary variable equalling 1 if facing a 50% SSI benefit reduction rate at the average earnings level for a work-limited individual of the same characteristics in the March CPS. "Likelihood in 50" is the probability of facing a 50% SSI benefit reduction rate given the distribution of earnings for a work-limited individual of the same characteristics in the March CPS. "Ever SSI" is whether the individual ever received SSI benefits.

*** p<0.01, ** p<0.05, * p<0.1

force during their benefit receipt spell, these elasticities are generally informative as to the response of earnings capacity to differing benefit reduction rates, and lends itself to direct comparability to the maximum likelihood estimation below. These earnings-level elasticities are larger than the participation elasticity estimates, with the two preferred specifications providing point estimates of -0.47 and -0.79, although these include both intensive and extensive labor supply responses.

Table 3.6 provides labor supply estimates with regard to log earnings and therefore drops all non-workers from the sample. The preferred specifications provide point estimates of -0.68 and -0.89. Although these estimates are higher than the participation elasticities, suggesting that once an SSDI beneficiary is working, she is more responsive to marginal incentives than when considering

Table 3.5

Effect of Facing 50% Benefit Reduction Rate on Administrative Earnings, OLS Results

	Ever SSI				
	(1)	(2)	(3)	(4)	(5)
Expected in 50	-8199.25***	-6996.04***	-8436.67***	-3826.27***	
	(149.92)	(212.96)	(340.36)	(489.73)	
Likelihood in 50					-15528.38***
					(1191.46)
Implied Elasticity [95% Range]	-1.02	-0.87	-1.05	-0.47	-0.79
	[-1.05, -0.98]	[-0.92, -0.82]	[-1.13, -0.96]	[-0.60, -0.35]	[-0.91, -0.67]
Demographics	No	Yes	Yes	Yes	Yes
Age, State, and Year Fixed Effects	No	No	Yes	Yes	Yes
Spousal Income	No	No	No	Yes	Yes
All Income When Not Working	No	No	No	Yes	Yes
R-squared	0.041	0.041	0.080	0.101	0.121
Observations	17719	17719	17719	17719	17719

Notes: OLS regression results from SIPP-SSA matched files. Dependent variable is SSA administrative earnings. Unit of observation is person-year. 1988-2002 sample window. Limited to those who received SSDI benefits at least one year ago. Demographics include education, occupation, industry, gender, and marital status. "Expected in 50" is a binary variable equalling 1 if facing a 50% SSI benefit reduction rate at the average earnings level for a work-limited individual of the same characteristics in the March CPS. "Likelihood in 50" is the probability of facing a 50% SSI benefit reduction rate given the distribution of earnings for a work-limited individual of the same characteristics in the March CPS. "Ever SSI" is whether the individual ever received SSI benefits.

*** p<0.01, ** p<0.05, * p<0.1

the extensive-margin employment decision, they are nevertheless inelastic estimates. The salient implication for the proposed benefit reduction rate is that although such a rate change may not have a large effect on labor force participation, there will be a great responsiveness among SSDI beneficiaries who are already in the labor force.

Additionally, estimates by wealth level in the latter two specifications show no significant difference among wealth level, nor any marked trends as one moves up the wealth distribution. Despite these elasticity estimates deriving from poorer SSDI beneficiaries, there does not appear to be much heterogeneity in these elasticities within the wealth distribution of this subsample, consistent with a broader applicability of these results.

Table 3.6

Effect of Facing 50% Benefit Reduction Rate on Log Administrative Earnings, OLS Results

	Ever SSI				By Wealth Level
	(1)	(2)	(3)	(4)	(5)
Expected in 50	-1.050***	-0.782***	-0.855***	-0.428***	
	(0.025)	(0.032)	(0.032)	(0.055)	
Expected in 50 X Negative Wealth					-0.421***
					(0.147)
Expected in 50 X 0					-0.383***
					(0.108)
Expected in 50 X 0 to 5,000					-0.506**
					(0.176)
Expected in 50 X 5,000 to 10,000					-0.365**
					(0.152)
Implied Elasticity [95% Range]	-1.58	-1.17	-1.28	-0.64	
	[-1.65, -1.50]	[-1.27, -1.08]	[-1.38, -1.19]	[-0.81, -0.48]	
Demographics	No	Yes	Yes	Yes	Yes
Age, State, and Year Fixed Effects	No	No	Yes	Yes	Yes
Spousal Income	No	No	No	Yes	Yes
All Income When Not Working	No	No	No	Yes	Yes
R-squared	0.061	0.062	0.090	0.131	0.122
Observations	12049	12049	12049	12049	8889

Notes: OLS regression results from SIPP-SSA matched files. Dependent variable is SSA administrative earnings. Unit of observation is person-year. 1988-2002 sample window. Limited to those who received SSDI benefits at least one year ago. Demographics include education, occupation, industry, gender, and marital status. "Expected in 50" is a binary variable equalling 1 if facing a 50% SSI benefit reduction rate at the average earnings level for a work-limited individual of the same characteristics in the March CPS. "Likelihood in 50" is the probability of facing a 50% SSI benefit reduction rate given the distribution of earnings for a work-limited individual of the same characteristics in the March CPS. "Ever SSI" is whether the individual ever received SSI benefits.

*** p<0.01, ** p<0.05, * p<0.1

3.4.2 Meyer and Rosenbaum (2001) Model

Although the above reduced form approach controlled for possible confounding variables, such as age, year, and state fixed effects and other income when not working, it also ignores many of the returns to work an SSDI beneficiary may face, over and above the incentives in SSI. In particular, such a beneficiary may be entitled to AFDC/TANF benefits or Food Stamps benefits even while working, or the tax code may have a positive or negative effect on returns to work, depending on one's EITC benefit. As such, a more comprehensive approach is necessary to determine what the net returns to work may be, and taking those into account, if there is a separate responsiveness to an additional 50% benefit reduction rate imposed by the SSI. To this end, I adapt the model used by

Meyer and Rosenbaum (2001) for labor force participation of single women facing changing AFDC and EITC benefits to the current case of SSDI beneficiaries facing changing SSI benefits.

There is a fundamental tradeoff between realism and complexity when modeling the returns to work facing a given individual. The interaction of so many programs creates highly complex budget constraints, and a researcher should include this complexity. However, there are two downsides that arise: the analysis itself loses tractability as the complexity grows, and an in-depth modeling of the entire budget constraint is most likely far beyond the understanding that the decision-makers being analyzed have. As such, the Meyer and Rosenbaum (2001) approach addresses this tradeoff by estimating overall income at different points in the hours-worked and wage distributions, then using these distributions, constructs an expectaction of the returns to work facing a particular individual. This approach has the strength of including much of the complexity that arises from the interactions of various social programs and tax systems but provides a tractable comparison for analysis.

The core of this analysis is the question: when would a SSDI beneficiary choose to work? Given that such an individual faces a random draw from a distribution of wages and hours worked, calculated as the distribution of wages and hours of similar individuals with work-limiting conditions in the March CPS, a beneficiary will work if the expected utility of working exceeds the utility from not working, i.e.:

$$Pr\left[E[U_w] > U_{nw}\right] \tag{3.2}$$

To estimate equation (3.2), we take an error term ϵ_k to be normal and U to be linear in income and nonmarket time. In the linear case, the decision has the simple form:

$$Pr\left[\alpha(E[Y_w] - Y_{nw}) + \beta(E[L_w] - L_{nw}) + \delta E[SSI_w] + X'\gamma > \epsilon_{nw} - \epsilon w\right] \tag{3.3}$$

where X consists of demogaphics, Y is income, L is nonmarket time, and SSI_w is whether an individual is receiving SSI benefits and faces a 50% benefit reduction rate. An assumption of normality results in equation (3.3) being rewritten with the normal cumulative distribution function Φ as:

$$\Phi\left[\alpha(E[Y_w] - Y_{nw}) + \beta(E[L_w] - L_{nw}) + \delta E[SSI_w] > 0 + X'\gamma\right] \tag{3.4}$$

Moreover, the vector α can contain distinct coefficients for each source of income: α_{tax}, α_{SNAP}, $\alpha_{benefits}$, $\alpha_{earnings}$, so that these different kinds of income can have different marginal contributions to utility. Taxes, SNAP, SSI, and AFDC/TANF benefits are calculated at the individual level in each state and year at each of the 60 intervals in the joint wage and hours distribution from the March CPS described above.

With this assumption of normality, probit estimation of labor force participation provides estimates of the above coefficients with regard to participation. Additionally, OLS estimation of log earnings will provide unbiased estimates

with regard to intensive margin decision-making given large sample asymptotics. Furthermore, OLS estimation of earnings levels will also allow for estimation of the same combination of intensive and extensive labor supply as discussed in the reduced form section. Results from these participation and earnings analyses are included in Tables 3.7, 3.8 and 3.9. Note that in Table 3.7, the results reported are the average marginal effects from the probit estimate of equation (3.4), while Tables 3.8 and 3.9 display OLS coefficents.

Similarly to the reduced form analysis, the inclusion of demographics, age, year, and state fixed effects do not substantially affect the estimates, while including income from in the no-work state as well as the total post-tax, post-transfer income from the working state does bring down the estimates dramatically. The implied elasticities for participation are in line with the higher end of the range estimated in the reduced form model, but they are largely consistent with the previous estimates, with a point value in preferred specification (3.4) of -0.3, but having a less precise 95% confidence interval of -0.09 to -0.50 which includes the prior estimates entirely. Again, these elasticities are not significantly different across different wealth levels, nor is there an obvious trend as one moves up the wealth distribution. The results are also not significantly different if one restricts the analysis to just single or married individuals. And again, these estimates suggest a low labor force participation responsiveness to differences in benefit reduction rates.

The earnings level elasticities in Table 3.8 are systematically, albeit not statistically significantly, lower than both the participation elasticities in Table 3.7 and the earnings level elasticities from the reduced form analysis. However, neither of these differences are statistically signficant, and we can reject at greater than

Table 3.7

Effect of Facing a 50% SSI Benefit Reduction Rate with Expected Work on Participation, Probit Average Marginal Effects

	(1)	(2)	(3)	(4)
Likelihood Faces 50% Benefit Reduction Rate When Working	-0.135**	-0.159***	-0.168***	-0.160***
	(0.047)	(0.045)	(0.056)	(0.052)
SSDI and SSI Concurrent Recipients at 0 Earnings	-0.093*	-0.105**	-0.108**	-0.105**
	(0.048)	(0.045)	(0.045)	(0.052)
SGA Level	0.00008	0.0002	0.0003	0.0001
	(0.0005)	(0.0005)	(0.0006)	(0.0006)
Implied Elasticity [95% Range]	-0.30	-0.35	-0.37	-0.35
	[-0.50, -0.09]	[-0.55, -0.15]	[-0.62, -0.13]	[-0.58, -0.13]
Demographics	Yes	Yes	Yes	Yes
Age, State, and Year Fixed Effects	Yes	Yes	Yes	Yes
Cash Transfer and SNAP when Not Working	Yes	Yes	Yes	Yes
Cash Transfer and SNAP when Working	Yes	Yes	Yes	Yes
Spousal Income	Yes	Yes	Yes	Yes
Wealth Restriction	Ever SSI	Less than 10,000	Less than 2,000	Nonnegative, less than 10,000
R-squared	0.038	0.040	0.045	0.043
Observations	14312	13072	8184	9932

Notes: OLS regression results from SIPP-SSA matched files. Dependent variable is SSA administrative earnings. Unit of observation is person-year. 1988-2002 sample window. Limited to those who received SSDI benefits at least one year ago. Demographics include education, occupation, industry, gender, and marital status. "Expected in 50" is a binary variable equalling 1 if facing a 50% SSI benefit reduction rate at the average earnings level for a work-limited individual of the same characteristics in the March CPS. "Likelihood in 50" is the probability of facing a 50% SSI benefit reduction rate given the distribution of earnings for a work-limited individual of the same characteristics in the March CPS. "Ever SSI" is whether the individual ever received SSI benefits.

*** p<0.01, ** p<0.05, * p<0.1

the 1% level that these estimates are elastic.

The log earnings analysis in Table 3.9 provides again provides intensive margin elasticitiy estimates higher than extensive margin elasticities, parallel to the

Table 3.8

Effect of Facing a 50% SSI Benefit Reduction Rate with Expected Work on SSA Administrative Earnings, OLS Coefficients

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Faces 50% Benefit Reduction Rate When Working	-8436.67***	-8446.12***	-1759.75***	-1877.35***	-2081.33**	-2248.01***	-2130.35**	-2279.10***
	(340.36)	(342.20)	(516.05)	(603.55)	(954.55)	(639.16)	(821.37)	(742.39)
Receiving SSI when Not Working			-821.88	-1130.79	-568.74	-959.95	-1110.02	-801.02
			(577.42)	(769.34)	(859.31)	(690.50)	(784.04)	(758.43)
SGA Level		3.09	-10.6	-2.17	3.07	-1.29	0.033	-2.036
		(2.25)	(5.67)	(7.10)	(12.87)	(6.23)	(8.25)	(7.56)
Implied Elasticity [95% Range]	-1.05	-1.05	-0.22	-0.23	-0.26	-0.28	-0.26	-0.28
	[-1.13, -0.96]	[-1.13, -0.96]	[-0.35, -0.09]	[-0.38, -0.08]	[-0.49, -0.02]	[-0.44, -0.12]	[-0.47, -0.06]	[-0.47, -.10]
Demographics, Age, State, Year Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cash Transfer when Not Working	No	No	Yes	Yes	Yes	Yes	Yes	Yes
SNAP Transfer when Not Working	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Cash Transfer and SNAP when Working	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Spousal Income	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Wealth Restriction	Ever SSI	Ever SSI	Ever SSI	Ever SSI	Ever SSI	Less than 10,000	Less than 2,000	Nonnegative, less than 10,000
R-squared	0.046	0.048	0.054	0.049	0.072	0.058	0.078	0.073
Observations	14312	14312	14312	8827	5485	13072	8184	9932
Sample	All	All	All	Single	Married	All	All	All

Notes: OLS regression results from SIPP-SSA matched files.Dependent variable is SSA administrative earnings. Unit of observation is person-year. 1988-2002 sample window. Limited to those who received SSDI benefits at least one year ago. Demographics include education, occupation, industry, gender, and marital status. Working condition defined as expected income bundle over the joint wage-hours distirbution of a work-limited individual with similar characteristics from the March CPS. "Ever SSI" is whether the individual ever received SSI benefits. "Wealth level" is self-reported non-housing wealth from the SIPP. Standard errors two-way clustered at person and year levels.

*** p<0.01, ** p<0.05, * p<0.1

reduced form analysis. However, in this more-inclusive estimation technique, these larger elasticities are only slightly larger, at -0.37 in the preferred specification and partially overlaps with the 95% confidence interval from the reduced

form estimates.

Table 3.9

Effect of Facing a 50% SSI Benefit Reduction Rate with Expected Work on Log SSA Administrative Earnings, OLS Coefficients

	(1)	(2)	(3)	(4)
Likelihood Faces 50% Benefit Reduction Rate When Working	-0.247***	-0.248***	-0.248**	-0.251***
	(0.058)	(0.063)	(0.102)	(0.075)
Receiving SSI when Not Working	-0.159***	-0.170***	-0.173**	-0.162**
	(0.056)	(0.063)	(0.082)	(0.072)
SGA Level	-0.00002	-0.00006	-0.00006	-0.00005
	(0.0008)	(0.0008)	(0.001)	(0.0008)
Implied Elasticity [95% Range]	-0.37	-0.37	-0.37	-0.38
	[-0.54, -0.20]	[-0.54, -0.20]	[-0.67, -0.07]	[-0.60, -.15]
Demographic Controls	Yes	Yes	Yes	Yes
Age, State, and Year Fixed Effects	Yes	Yes	Yes	Yes
Cash Transfer and SNAP when Not Working	Yes	Yes	Yes	Yes
Cash Transfer and SNAP when Working	Yes	Yes	Yes	Yes
Spousal Income	Yes	Yes	Yes	Yes
Wealth Restriction	Ever SSI	Less than 10,000	Less than 2,000	Nonnegative, less than 10,000
R-squared	0.079	0.084	0.093	0.084
Observations	9732	8889	5565	6754

Notes: OLS regression results from SIPP-SSA matched files. Dependent variable is SSA administrative log earnings. Unit of observation is person-year. 1988-2002 sample window. Limited to those who received SSDI benefits at least one year ago. Demographics include education, occupation, industry, gender, and marital status. "Expected in 50" is a binary variable equalling 1 if facing a 50% SSI benefit reduction rate at the average earnings level for a work-limited individual of the same characteristics in the March CPS. "Likelihood in 50" is the probability of facing a 50% SSI benefit reduction rate given the distribution of earnings for a work-limited individual of the same characteristics in the March CPS. "Ever SSI" is whether the individual ever received SSI benefits.

*** p<0.01, ** p<0.05, * p<0.1

Overall, both of these analyses provide consistently low estimates of labor force participation, in line with Gruber (2000)'s estimates from the Canadian

disability system, implying that there is little reactivity to benefit reduction rates alone, either on the intensive or extensive margin. Additionally, the consistently lower, albeit noisier log earnings elastictiy estimates from the Meyer and Rosenbaum (2001) approach suggest that not including the full range of returns from work can upwardly bias responsiveness to disability benefit reduction rates, perhaps due to tax credits such as the EITC.

This Meyer and Rosenbaum (2001) approach provides the clearest modeling of the complex budget constraint facing these SSDI beneficiaries without many structural assumptions. As such, it is the preferred specification in this paper. However, the strongest underlying assumption is that an individual faces a distribution consistent with that in the March CPS and that he or she is aware of this wage and hours-worked distribution. To relax this assumption and to include the entire possible budget constraint an individual may face, the next section follows a structural approach to estimating labor supply elasticities by including more assumptions about the form of the individual's labor supply function, but allowing for a direct and well-identified estimate of the parameter of interest.

3.4.3 Maximum Likelihood Kinked Budget Constraint Model

The above Meyer and Rosenbaum (2001) model took into account the average return to work facing an individual across nearly all channels in the tax and transfer system. However, it provided estimates based on expectations over a set of earnings. In the event that SSDI beneficiaries' possible earnings from employment differs systematically from the earnings distribution used, the re-

sults will be biased. Additionally, in as much as individuals may change their earnings based on the structure of the implicit marginal tax they face, OLS or probit analyses above will also be biased. In order to correct for these possible biases, I use a maximum likelihood estimation technique that explicitly includes the entire budget constraint an SSDI beneficiary faces when choosing her labor supply.

I use the maximum likelihood estimation technique pioneered by Burtless and Hausman (1978) and Moffitt (1986)'s design, and adapted by Friedberg (2000) to study Social Security kinked budgets constraints. In particular, Friedberg (2000) estimates labor supply elasticities by exploiting changes in the Social Security retirement benefit earnings test. Friedberg (2000)'s likelihood function had three sections with one potential kink and the truncation of non-workers. Because of the more complex interactions between SSDI and SSI and because the participation decision is of vital importance to the policy proposal at hand, the likelihood function included in this analysis has five sections and three kinks, and specifically includes non-workers.

Following Burtless and Hausman (1978) and Friedberg (2000), a beneficiary's choice of hours H is determined by:

$$H(w, Y, X, \alpha) = \kappa + X\beta + \gamma w(1 - \tau) + \delta Y + \alpha = Z\theta + \alpha \tag{3.5}$$

where w is the gross wage, $w(1 - \tau)$ is the net wage, Y is virtual income, X are demographics, and α represents unobserved heterogeneity in preferences.

There are five possible income/net wage regimes a beneficiary could fall under due to the SSDI and SSI program interactions describes above which are

described in Table 3.10.

Table 3.10

SSI Benefit Reduction Rates and Virtual Income for Maximum Likelihood Estimation

j	Earnings Regime	τ_SSI	Y
1	Under the $65 earnings disregard	0	SSI + 20
2	Over the disregard, positive SSI income, under SGA	0.5	SSI + 65/2 + 20
3	SSI Income = 0, under SGA	0	SSDI
4	Over SGA, positive SSI Income	0.5	SSI +65/2
5	Over SGA, SSI Income = 0	0	0

Additionally, note that the kinks in the budget constraint are: 1) the $65 SSI earnings offset; 2) the earnings under the SGA level at which SSI benefits are entirely offset by the SSDI benefit, determined by:

$$Earnings(SSI = 0) = 2 * (SSI_{Federal} + SSI_{State} - (SSDI - 20)) + 65$$

3) the SGA level itself; and 4) the earnings above the SGA level at which SSI benefits are entirely offset by earnings:

$$Earnings(SSI = 0, SSDI = 0) = 2 * (SSI_{Federal} + SSI_{State}) + 65$$

Kinks 1 and 3 are convex and thus may involved bunching, while kinks 2 and 4 are concave and thus correspond to areas wherein individuals will not locate.

In addition to this benefit reduction rate, τ_{SSI}, the overall implicit marginal tax rate includes the payroll tax, federal income tax, and federal EITC rates, i.e. $\tau = \tau_{SSI} + \tau_{tax}$. If married, these tax rates are evaluated with both spousal earnings and own earnings. In this analysis, no additional social programs were included; this exclusion is due to a particular criticism of this maximum likelihood technique: if there is mismeasurement of either the dependent variable or the budget constraint used by the individual when deciding on his or her labor supply, then the parameters estimated are no longer unbiased or consistent.

In each specification, gross wage is the predicted wage drawn from distribution of wages for individuals reporting work-limiting disabilities in the March Current Population Survey.[12] Separate wages are predicted depending on gender, marital status, having any children, and pre/post-1996. Demographics controls include a linear time trend, white, Hispanic status, having any children, marital status, gender, a linear age trend, and region (Northeast, South, Midwest, West).

The dependent variable is either self-reported hours worked H_{it} or self-reported earnings E_{it} (where in only implicit marginal tax rates are used and not net wages), both available on the monthly level. These observations are available only while an individual is in a SIPP Panel, and thus stretch for 2 to 4 year periods, depending on which panel they are in. For example, for those in the 1996 SIPP Panel, I observe their self-reported hours worked up through

[12] Although the gross wage could be directly calculated for working SSDI beneficiaries by dividing earnings by hours-worked, doing so would lead to possible "Division Bias" issues (Borjas 1980).

1999. Since the first panel is available starting in 1990, there are no individuals for whom I see monthly hours-worked across the two major SGA changes. The variation driving this analysis is therefore in real changes in SSI benefits, as well as structurally modeling virtual income, allowing for comparison across individuals with different SSDI benefits. The same problem is encountered using the self-reported monthly earnings. However, this analysis requires a monthly-level resolution, since the budget constraint parameters only hold on the monthly level and do not aggregate up to the annual level. Therefore, this analysis sacrifices some exogenous variation in exchange for much greater measurement of the actual budget constraint, the former of which is of first-order importance in maximum likelihood budget constraint estimation (Friedberg 2000).

Combining all of these components together yields the following maximum likelihood equation for each individual i. Note that each component has an indicator variable, corresponding to 1 if an individual is on that particular portion of the likelihood function in the month in question and 0 otherwise, indicated by a K or an S, depending if they are at one of the three kinks in the budget constraint (no-work, \$65 earnings disregard, and SGA) or at the interior of a segment. For some individuals, their SSDI benefit is so large that they will have a zero SSI benefit at any earnings level below SGA. These individuals are indicated by the variable $I_{0i} = 0$. Alternatively, for some SSDI beneficiaries, their SSI benefits are high enough such that no earnings level under SGA will reduce their SSI benefit to zero. These individuals are indicated by the variable $I_{1i} = 0$.

$$
\begin{aligned}
log(L(H_{it})) = {} & K_{0i} * I_{0i} * \log\left[\int_{-\infty}^{-Z_{1i}\theta} \frac{1}{\sigma_\alpha}\phi\left(\frac{\alpha_i}{\sigma_\alpha}\right) d\alpha_i\right] \\
+ {} & K_{0i} * (1 - I_{0i}) * I_{1i} * \log\left[\int_{-\infty}^{-Z_{3i}\theta} \frac{1}{\sigma_\alpha}\phi\left(\frac{\alpha_i}{\sigma_\alpha}\right) d\alpha_i\right] \\
+ {} & K_{0i} * (1 - I_{0i}) * (1 - I_{1i}) * \log\left[\int_{-\infty}^{-Z_{4i}\theta} \frac{1}{\sigma_\alpha}\phi\left(\frac{\alpha_i}{\sigma_\alpha}\right) d\alpha_i\right]
\end{aligned}
$$

$$
\begin{aligned}
&+ S_{1i} * I_{0i} * \log\left[\tfrac{1}{\sigma_\alpha}\phi\left(\tfrac{\alpha_i = H_i - Z_{1i}\theta}{\sigma_\alpha}\right)\right] \\
&+ K_{1i} * I_{0i} * \log\left[\int_{H_i - Z_{1i}\theta}^{H_i - Z_{2i}\theta} \tfrac{1}{\sigma_\alpha}\phi\left(\tfrac{\alpha_i}{\sigma_\alpha}\right) d\alpha_i\right] \\
&+ S_{2i} * I_{0i} * \log\left[\tfrac{1}{\sigma_\alpha}\phi\left(\tfrac{\alpha_i = H_i - Z_{2i}\theta}{\sigma_\alpha}\right) * \Phi\left(\tfrac{\alpha'_{2,3}}{\sigma_\alpha}\right)\right] \\
&+ S_{3i} * I_{1i} * \log\left[\tfrac{1}{\sigma_\alpha}\phi\left(\tfrac{\alpha_i = H_i - Z_{3i}\theta}{\sigma_\alpha}\right) * \left(1 - I_{0i} * \Phi\left(\tfrac{\alpha'_{2,3}}{\sigma_\alpha}\right)\right)\right] \\
&+ K_{2i} * I_{1i} * \log\left[\int_{H_i - Z_{2i}\theta}^{H_i - Z_{3i}\theta} \tfrac{1}{\sigma_\alpha}\phi\left(\tfrac{\alpha_i}{\sigma_\alpha}\right) d\alpha_i\right] \\
&+ S_{4i} * \log\left[\tfrac{1}{\sigma_\alpha}\phi\left(\tfrac{\alpha_i = H_i - Z_{4i}\theta}{\sigma_\alpha}\right) * \Phi\left(\tfrac{\alpha'_{4,5}}{\sigma_\alpha}\right)\right] \\
&+ S_{5i} * \log\left[\tfrac{1}{\sigma_\alpha}\phi\left(\tfrac{\alpha_i = H_i - Z_{5i}\theta}{\sigma_\alpha}\right) * \left(1 - \Phi\left(\tfrac{\alpha'_{4,5}}{\sigma_\alpha}\right)\right)\right]
\end{aligned}
$$

$$H_i - Z_{ji}\theta = H_i - \kappa - X_i\beta - \gamma w_i(1 - \tau_j) - \delta Y_{ji}$$

$$j = 1, 2, 3, 4, 5$$

The terms involving $\alpha'_{k-1,k}$ variables correspond to the nonconvex kinks wherein an individual will not locate. Therefore, α'_k is the value of α wherein the individual's indifference curve is tangent to both the lower slope prior segment and the higher slope subsequent segment. It is computed by equating the indirect utility functions given by the linear labor supply function for these two segments: $e^{\delta w(1-\tau_{k-1})}\left(y_{k-1} + \frac{\gamma}{\delta}w(1-\tau_{k-1}) - \frac{\gamma}{\delta^2} + \frac{\kappa + X\beta + \alpha'_{k-1,k}}{\delta}\right) =$
$e^{\delta w(1-\tau_k)}\left(y_k + \frac{\gamma}{\delta}w(1-\tau_k) - \frac{\gamma}{\delta^2} + \frac{\kappa + X\beta + \alpha'_{k-1,k}}{\delta}\right)$

This maximum likelihood formula is then maximized using Stata's standard Newton-Raphson algorithm on the pseudo-maximum likelihood generated by clustering at the individual level. Convergence was achieved in all maximizations.

Although the above maximum likelihood function follows the program rules consistent with constant earnings levels, this function is misspecificed in the

event that SSDI beneficiaries consider exceeding the Trial Work Period threshold as program exit instead of exceeding the Substantial Gainful Activity level.[13] To this end, I reestimate the above maximum likelihood function, but I replace the SGA level with the TWP level. Results are reported in Tables 3.11 and 3.12.

All parameters are estimated with the predicted signs, and most are highly statistically significant. The parameter of greatest interest in the hours-worked analysis reported in Table 3.11 is "Net wage," which can be interpreted as the change in monthly hours worked when the net wage increases by $1. This parameter is precisely estimated at about 3.5 hours worked across both specifications. The implied elasticity is within a 95% confidence interval of -0.5 to -0.72. Given the structure of this estimation, there is not a direct comparison available to the results in the two previous sections, since the dependent variable is hours worked, the frequency is monthly, and the estimate includes both intensive and extensive labor supply responses. However, this estimate is about twice that of older working Social Security retirement benefit recipients reported in Friedberg (2000) and what was estimated in Table 3.7, although even with this greater magnitude, it shows that the labor supply of DI beneficiaries with regard to benefit reduction rates is nevertheless inelastic.

Table 3.12 provides similar estimates of the effect of the implicit marginal tax rate on earnings. Again, these elasticities, estimated at -0.68 and -0.65, are higher than those estimated in the structural analysis, albeit with substantially overlapping confidence intervals with the reduced form analysis, once again providing evidence that SSDI beneficiaries already in the work-force are more likely to respond to disability benefit reduction rates than those contemplating joining the

[13] Anecdotal evidence from the Benefit Offset National Demonstration suggests that some SSDI beneficiaries considering work anchor these work decisions around the TWP threshold in order to not jeopardize the long-term stability of their benefits.

Table 3.11

Maximum Likelihood Parameters Estimates from Monthly Hours Worked Analysis

	(1) SGA	(2) TWP
Time Trend	-0.97***	-1.41***
	(0.20)	(0.23)
Age Trend	-2.44***	-2.53***
	(0.04)	(0.04)
White	6.31***	6.60***
	(1.12)	(1.22)
Hispanic	-20.37***	-22.04***
	(1.97)	(2.11)
Any Children	8.44***	-3.14
	(2.08)	(2.07)
Married	3.87**	3.55
	(1.91)	(2.22)
Male	42.78***	48.66***
	(2.00)	(2.19)
Net wage	3.57***	3.43***
	(0.26)	(0.28)
Virtual Income	-0.007***	-0.014***
	(0.002)	(0.002)
ln(σ)	5.108***	5.213***
	(0.005)	(0.006)
Implied wage elasticity [95% Range]	-0.628	-0.603
	[-0.535, -0.722]	[-0.504, -0.702]
Region Controls	Yes	Yes
Log pseudolikelihood	-2,386,223	-2,278,266
Clusters	29,469	29,469
Number of Observations	842,666	842,666

Notes: Maximum likelihood estimation results from SIPP-SSA matched files. Dependent variable is self-reported monthly hours worked. Unit of observation is person-month. 1990-2002 sample window. Limited to those who received SSDI benefits at least one year ago, under 62 years of age, and have under $10,000 in self-reported non-housing wealth. Standard errors clustered at the individual level. "SGA" column places the SSDI cliff at the Substantial Gainful Activity level, while "TWP" column places the cliff at the smaller Trial Work Period threshold level. Net wage includes payroll and federal income tax, as well as 50% SSI benefit reduction rate when appropriate

*** p<0.01, ** p<0.05, * p<0.1

work-force. There is evidence that this technique generally produces overestimates of labor supply elasticities, since Friedberg (2000)'s analysis found the most reactivity of any analysis in the earnings test literature. Additionally, the

Table 3.12

Maximum Likelihood Parameters Estimates from Monthly Earnings Analysis

	(1) SGA	(2) TWP
Time Trend	-18.1***	-28.0***
	(4.1)	(5.3)
Age Trend	-50.2***	-52.2***
	(0.7)	(1.2)
White	140.2***	142.0***
	(25.3)	(1.22)
Hispanic	-420.2***	-443.7***
	(35.8)	(39.2)
Any Children	172.2*	-28.2*
	(88.3)	(15.2)
Married	163.2***	233.8***
	(35.6)	(45.5)
Male	534.4***	552.2***
	(83.3)	(90.2)
Implicit Marginal Tax	79.2***	82.2***
	(28.2)	(30.3)
Virtual Income	-0.23***	-0.27***
	(0.08)	(0.09)
ln(σ)	6.28***	6.43***
	(0.01)	(0.01)
Implied wage elasticity [95% Range]	-0.68	-0.65
	[-0.31, -1.02]	[-0.36, -0.92]
Region Controls	Yes	Yes
Log pseudolikelihood	-1,588,923	-1,437,112
Clusters	29,469	29,469
Number of Observations	842,666	842,666

Notes: Maximum likelihood estimation results from SIPP-SSA matched files. Dependent variable is self-reported monthly earnings. Unit of observation is person-month. 1990-2002 sample window. Limited to those who received SSDI benefits at least one year ago, under 62 years of age, and have under $10,000 in self-reported non-housing wealth. Standard errors clustered at the individual level. "SGA" column places the SSDI cliff at the Substantial Gainful Activity level, while "TWP" column places the cliff at the smaller Trial Work Period threshold level. Net wage includes payroll and federal income tax, as well as 50% SSI benefit reduction rate when appropriate

*** p<0.01, ** p<0.05, * p<0.1

data itself suggest concerns as to bias and precision: because the analysis must be monthly, one strong source of variation is lost in that I observe no individual across any large SGA shift. In as much as an identifying assumption of

this approach is that exogeneity of the budget constraint due to policy changes overpowers endogeneity of high wage workers with high amounts of labor supply, the results from this analysis may be biased upward. Moreover, since the wages used herein are predicted instead of actual, and the dependent variables are self-reported instead of administrative, the overall precision of the estimates is lessened, and any inherent bias in any of these approximations will correspondingly bias the results. Nevertheless, these estimates are inelastic and are just above the high 95% confidence interval estimates in the preferred analysis.

3.5 Conclusion

This paper used a previously unexploited source of variation as a quasi-experiment to identify and estimate labor supply elasticities for Social Security Disability Insurance recipients with regard to changes in disability benefit reduction rates. Across specifications and techniques, ranging from reduced form to structural maximum likelihood estimation, this analysis found that SSDI recipients' labor supply is relatively inelastic to changes in disability benefit reduction rates. I used the variation in benefit reduction rate faced by SSDI recipients who are SSI eligible or near-eligible generated by geographical and temporal differences in parameters in both programs. Since this variation in benefit reduction rate (zero vs. 50%) is the same as a leading proposal to encourage work among SSDI recipients, these inelastic estimates of labor supply elasticities suggest that such a proposal will have at most limited success in encouraging labor force participation among this population, albeit slightly more success at increasing earnings of those already working.

However, the applicability of these elasiticity estimates for the population at large is limited in that the variation exploited is largely limited to the poorer segment of the SSDI population who may also be eligible for SSI. This issue was addressed by estimating the effect of this variation across the wealth distribution of SSI eligible and near-eligible individuals. There was no significant difference in effect across this distribution, nor was there any distinctive pattern in this effect. Additionally, the estimated elasticities are in line with estimates in the literature using different sources of variation on different populations, suggesting that the external validity of these estimates is not limited to only SSDI-SSI concurrent beneficiaries.

Although the Benefit Offset National Demonstration is currently in the process of implementing a randomized control trial to experimentally estimate similar elasticities, the analysis in this paper is based on variation in an existing setting and thus avoids any possible Hawthorne or information effects that could drive reactivity in the BOND study. Also, this analysis specifically exploits the interactions between SSI and SSDI, allowing for a full understanding of the marginal incentives facing many SSDI beneficiaries, while previous work on the topic either ignores or simply controls for SSI receipt, assuming an independent effect of this other program on work behavior. As such, this paper is the first to provide labor supply estimates for US disability insurance beneficiaries based on changes in the disability benefit reduction rate, as opposed to rate changes in other countries or variation in program acceptance or rejection in the US. The low elasticities estimated suggest that there will not be much labor supply responsiveness among SSDI beneficiaries to changes in disability benefit reduction rates.

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APPENDIX A

APPENDIX TABLES

Appendix Table 1.1

Effect of Statement Receipt on Reporting a Health Condition

	Dependent Variable: Reporting Any				
	ADL	iADL	Mental	Back	Work-Limiting
Statement Receipt	0.0041	-0.0047	0.0034	0.0009	0.0128
	[0.0049]	[0.0032]	[0.0071]	[0.0061]	[0.0073]*
5-year Age Group X Year Dummies	Yes	Yes	Yes	Yes	Yes
N	40308	40308	40308	40308	40308
R-Squared	0.006	0.153	0.069	0.096	0.017

Note: OLS Linear Probability regression results from HRS waves 1-7. All regressions control for education, race, gender, and marital status.

*** p<0.01, ** p<0.05, * p<0.1

Appendix Table 2.1

Effect of Statement Receipt on Annual Self-Reported Earnings Excluding Top 5% of Earners, Linear Regression Results, 1992-2002

	(1)	(2)	(3)	(4)	(5)	(6)
	Self-Reported Earnings from All Jobs per Year, 2000 Dollars					
Ever Received Statement	2208	731.3		5552	2238	1017
	[987.9]**	[1226]		[2275]**	[1112]**	[1129]
Age Category X Statement	.					
40 to 44			12196			
			[7566]			
45 to 49			7433			
			[4514]*			
50 to 54			-3332			
			[1817]*			
55 to 59			-993.5			
			[1057]			
60 to 62			2700			
			[1808]			
Less than High School X Statement						
High School X Statement				-1719		
				[1337]		
College X Statement				-15516		
				[4777]***		
More than College X Statement				-19334		
				[6296]***		
Had a 2nd Job Last Interview					-4444	
					[2742]	
2nd Job Last Interview X Statement					206.9	
					[2416]	
Ever Received 2 Statements						2805
						[1406]**
Age Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Age Category Control	No	No	Yes	No	No	No
Pre-Statement Hour Category Controls	No	Yes	Yes	Yes	Yes	Yes
Only OAI Qualified	Yes	Yes	Yes	Yes	Yes	Yes
Constant	11068	15438	11648	15758	18123	15466
	[517.0]***	[774.5]***	[5512]**	[786.0]***	[12879]	[774.4]***
Observations	10034	10034	9986	10034	10034	10034
R-squared	0.093	0.116	0.112	0.125	0.121	0.116

Notes: Unit of observation is person-wave. Dependent variable is self-reported earnings across all jobs in the reference year, price adjusted to 2000 dollars with the CPI-U-RS. Sample limited to under age 62 men fully insured for Old Age Insurance in 1991 (those with at least 40 Quarters of Coverage by 1992). Additionally, the top 5% of overall earners (sum of real earnings from 1992-2002) are dropped. All regressions control for marital status, education, race, and age and year fixed effects; standard errors in brackets are two-way clustered at year and birth-year levels, 1992-2002 (i.e. HRS waves 2-6). All specifications are unweighted OLS.

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Appendix Table 2.2a	Mean
Descriptive Statistics, Weighted	(SD)
Dependent Variables	
Annual Hours Worked	1760.91
	(1,179.49)
Self-Employment Annual Hours Worked	419.31
	(1,010.79)
Self-Reported Annual Earnings	37,354.99
	(69,343.22)
Adminstrative Annual Earnings	28,021.21
	(24,754.33)
Decreased Expected PIA	0.28
	(0.45)
ln(Self-Reported Earnings)	10.09
	(1.22)
ln(Hours Worked)	7.67
	(0.48)
Independent Variables	
Age	57.24
	(2.90)
White	0.908
	(0.289)
Married	0.848
	(0.359)
High School	0.505
	(0.500)
College	0.123
	(0.329)
More than College	0.121
	(0.326)
Ever Received Statement	0.390
	(0.488)
Ever Received 2 Statements	0.135
	(0.342)
Had Second Job Before 1st Statement	0.122
	(0.328)

Hours Worked Category Pre-Statement among those with Positive Hours Worked Pre-Statement

	All Hours Worked	Self-Employed Hours Worked
1 to 9 per Week	12.95%	80.91%
10 to 19 per Week	1.92%	0.96%
20 to 29 per Week	3.95%	1.78%
30 to 39 per Week	7.11%	2.35%
Exactly 40 per Week	27.01%	2.08%
Over 40 per Week	47.07%	11.91%

Note: Descriptive statistics from 1992-2002 Health and Retirement Study, matched to SSA administrative records, from sample restrictions outlined in Table 1, weighted with 1994 HRS person-level weights.

Appendix Table 2.2b Descriptive Statistics, Weighted, cont'd	Mean (SD)
Received a Statement by w-1	0.27
	(0.45)
Decreased Hours between w-2 and w-1	0.19
	(0.39)
Decreased Hours X Statement by w-1	0.10
	(0.31)
Decreased Hours X 2nd Statement Between w-1 and w	0.06
	(0.25)
Decreased Earnings between w-1 and w-2	0..20
	(0.40)
Decreased Earnings X Statement by w-1	0.12
	(0.32)
Decreased Earnings X 2nd Statement Between w-1 and w	0.08
	(0.26)
Decreased Earnings between w-1 and w	0.29
	(0.46)
Decreased Earnings X Statement by w	0.16
	(0.37)
ln(Expected PIA)	6.72
	(0.52)

Note: Descriptive statistics from 1992-2002 Health and Retirement Study, matched to SSA administrative records, from sample restrictions outlined in Table 1, weighted with 1994 HRS person-level weights.

Appendix Table 2.3

Effect of Statement Receipt on Annual Hours Worked, Linear Regression Results, 1992-2002

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Self-Reported Hours Worked per Year						
Ever Received Statement	-32.86	-249.8	-	-163.4	-212.3	-291.5	-
	[23.08]	[57.39]***	-	[58.68]***	[57.76]***	[35.68]***	-
Age Category X Statement							
50 to 54			-59.11				
			[80.61]				
55 to 59			-207.5				
			[43.79]***				
60 to 61			-419.0				
			[57.52]***				
Less than High School X Statement				-			
				-			
High School X Statement				-128.0			
				[58.99]**			
College X Statement				-66.22			
				[114.1]			
More than College X Statement				-104.6			
				[104.9]			
Had a 2nd Job Before Statement Receipt					238.1		
					[54.78]***		
2nd Job X Statement					-300.9		
					[83.75]***		
Ever Received 2 Statements						-331.0	
						[108.0]***	
Pre-Statement Hours Worked Category X Statement							
1 to 9 per Week							662.0
							[80.19]***
10 to 19 per Week							48.61
							[142.7]
20 to 29 per Week							84.18
							[64.40]
30 to 39 per Week							-44.29
							[108.2]
Exactly 40 per Week							-369.1
							[53.63]***
Over 40 per Week							-620.8
							[52.89]***
Age Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age Category Control	No	No	Yes	No	No	No	No
Pre-Statement Hour Category Controls	No	Yes	Yes	Yes	Yes	Yes	Yes
Only OAI Qualified	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	4330	2265	1613	2215	2055	2261	1660
	[43.01]***	[253.9]***	[366.2]***	[233.0]***	[204.7]***	[253.6]***	[16.72]***
Observations	10145	10145	10144	10145	10145	10145	10145
R-squared	0.073	0.525	0.524	0.525	0.528	0.529	0.562

Notes: Unit of observation is person-wave. Dependent variable is self-reported hours worked across all jobs in the reference year. Sample limited to under age 62 men fully insured for Old Age Insurance in 1991 (those with at least 40 Quarters of Coverage by 1992). All regressions control for marital status, education, race, and age and year fixed effects; standard errors in brackets are two-way clustered at year and birth-year levels, 1992-2002 (i.e. HRS waves 2-6). All specifications are OLS weighted with the 1994 HRS person-level weights.

* Significant at 10% level

** Significant at 5% level

*** Significant at 1% level

Appendix Table 2.4

Effect of Statement Receipt on Annual Self-Employment Hours Worked, Linear Regression Results, 1992-2002

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Self-Reported, Self-Employment Hours Worked per Year						
Ever Received Statement	60.31	-11.68		36.41	0.752	-15.65	
	[23.71]**	[15.83]		[25.18]	[13.90]	[15.47]	
Age Category X Statement							
50 to 54			-18.95				
			[18.12]				
55 to 59			9.754				
			[11.30]				
60 to 61			-43.21				
			[16.85]**				
Less than High School X Statement							
High School X Statement				-70.88			
				[41.70]*			
College X Statement				-53.24			
				[34.42]			
More than College X Statement				-44.09			
				[31.97]			
Had a 2nd Job Before Statement Receipt					86.16		
					[18.56]***		
2nd Job X Statement					-104.4		
					[58.69]*		
Ever Received 2 Statements						-31.52	
						[34.22]	
Pre-Statement Hours Worked Category X Statement							
1 to 9 per Week							138.7
							[21.09]***
10 to 19 per Week							-164.0
							[222.5]
20 to 29 per Week							59.81
							[144.3]
30 to 39 per Week							-14.08
							[98.73]
Exactly 40 per Week							-642.6
							[187.1]***
Over 40 per Week							-960.1
							[122.3]***
Age Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age Category Control	No	No	Yes	No	No	No	No
Pre-Statement Hour Category Controls	No	Yes	Yes	Yes	Yes	Yes	Yes
Only OAI Qualified	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-105.5	8.513	7.163	-18.41	-74.65	8.247	3.15e-10
	[21.11]**	[19.51]	[19.31]	[15.61]	[22.08]***	[19.33]	[0.000639]
Observations	10145	10145	10144	10145	10145	10145	10145
R-squared	0.010	0.757	0.757	0.757	0.758	0.757	0.787

Notes: Unit of observation is person-wave. Dependent variable is self-reported hours worked across all self-employment jobs in the reference year. Sample limited to under age 62 men fully insured for Old Age Insurance in 1991 (those with at least 40 Quarters of Coverage by 1992). All regressions control for marital status, education, race, and age and year fixed effects; standard errors in brackets are two-way clustered at year and birth-year levels, 1992-2002 (i.e. HRS waves 2-6). All specifications are OLS weighted with the 1994 HRS person-level weights.

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Appendix Table 2.5

Effect of Statement Receipt on Annual Self-Reported Earnings, Linear Regression Results, 1992-2002

	(1)	(2)	(3)	(4)	(5)	(6)
	Self-Reported Earnings from All Jobs per Year, 2000 Dollars					
Ever Received Statement	891.3	-1363		2685	-3279	-2188
	[1153]	[1173]		[940.3]***	[1280]**	[1764]
Age Category X Statement						
50 to 54			3583			
			[1791]**			
55 to 59			-3774			
			[1048]***			
60 to 62			-6200			
			[4311]			
Less than High School X Statement						
High School X Statement				-4011		
				[1408]***		
College X Statement				-10730		
				[8146]		
More than College X Statement				-5124		
				[5548]		
Had a 2nd Job Last Interview					-8249	
					[4620]*	
2nd Job Last Interview X Statement					15483	
					[4640]***	
Ever Received 2 Statements						-6812
						[2896]**
Age Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Age Category Control	No	No	Yes	No	No	No
Pre-Statement Hour Category Controls	No	Yes	Yes	Yes	Yes	Yes
Only OAI Qualified	Yes	Yes	Yes	Yes	Yes	Yes
Constant	110469	69508	69782	66300	68863	69291
	[1519]***	[3059]***	[7622]***	[2772]***	[3104]***	[3016]***
Observations	9684	9684	9683	9684	9684	9684
R-squared	0.058	0.099	0.095	0.101	0.099	0.099

Notes: Unit of observation is person-wave. Dependent variable is self-reported earnings across all jobs in the reference year, price adjusted to 2000 dollars with the CPI-U-RS. Sample limited to under age 62 men fully insured for Old Age Insurance in 1991 (those with at least 40 Quarters of Coverage by 1992). All regressions control for marital status, education, race, and age and year fixed effects; standard errors in brackets are two-way clustered at year and birth-year levels, 1992-2002 (i.e. HRS waves 2-6). All specifications are OLS weighted with the 1994 HRS person-level weights.

* Significant at 10% level

** Significant at 5% level

*** Significant at 1% level

Appendix Table 2.6

Effect of Statement Receipt on Annual Administrative Earnings, Linear Regression Results, 1992-2002

	(1)	(2)	(3)	(4)	(5)
	Administrative SSA Earnings, 2000 Dollars				
Ever Received Statement	323.9		1433	-730.5	505.2
	[720.7]		[874.8]	[1062]	[787.0]
Age Category X Statement					
50 to 54		4254			
		[1509]***			
55 to 59		-2125			
		[1126]*			
60 to 62		-1523			
		[1503]			
Less than High School X Statement					
High School X Statement			-1822		
			[646.2]***		
College X Statement			331.8		
			[588.8]		
More than College X Statement			-2205		
			[1661]		
Had a 2nd Job Last Interview				-1094	
				[1866]	
2nd Job Last Interview X Statement				1194	
				[1378]	
Ever Received 2 Statements					956.9
					[1267]
Age Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Age Category Control	No	Yes	No	No	No
Pre-Statement Hour Category Controls	Yes	Yes	Yes	Yes	Yes
Only OAI Qualified	Yes	Yes	Yes	Yes	Yes
Constant	15438	11648	15758	15758	15466
	[774.5]***	[5512]**	[786.0]***	[12879]	[774.4]***
Observations	12693	12693	12693	12693	12693
R-squared	0.116	0.112	0.125	0.121	0.116

Notes: Unit of observation is person-wave. Dependent variable is SSA administrative Summary File earnings in the reference year, price adjusted to 2000 dollars with the CPI-U-RS. Sample limited to under age 62 men fully insured for Old Age Insurance in 1991 (those with at least 40 Quarters of Coverage by 1992). Additionally, the top 5% of overall earners (sum of real earnings from 1992-2002) are dropped. All regressions control for marital status, education, race, and age and year fixed effects; standard errors in brackets are two-way clustered at year and birth-year levels, 1992-2002 (i.e. HRS waves 2-6). All specifications are OLS weighted with the 1994 HRS person-level weights, reweighted with the inverse predicted probability of rematching SSA records in 2004 from a logit model.

* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

Appendix Table 3.1

Effect of Facing 50% Benefit Reduction Rate on Labor Force Participation above SGA Level, OLS Results

	Ever SSI				
	(1)	(2)	(3)	(4)	(5)
Expected in 50	-0.267***	-0.243***	-0.298***	-0.121***	
	(0.004)	(0.007)	(0.009)	(0.014)	
Likelihood in 50					-0.435***
					(0.031)
Implied Elasticity [95% Range]	-0.59	-0.54	-0.66	-0.27	-0.44
	[-0.61, -0.57]	[-0.57, -0.51]	[-0.70, -0.62]	[-0.33, -0.21]	[-0.45, -0.34]
Demographics	No	Yes	Yes	Yes	Yes
Age, State, and Year Fixed Effects	No	No	Yes	Yes	Yes
Spousal Income	No	No	No	Yes	Yes
All Income When Not Working	No	No	No	Yes	Yes
R-squared	0.052	0.054	0.080	0.018	0.043
Observations	17719	17719	17719	17719	17719

Notes: OLS regression results from SIPP-SSA matched files. Participation above SGA defined as SSA earnings above 12 times the monthly SGA in a year. Unit of observation is person-year. 1988-2002 sample window. Limited to those who received SSDI benefits at least one year ago. Demographics include education, occupation, industry, gender, and marital status. "Expected in 50" is a binary variable equalling 1 if facing a 50% SSI benefit reduction rate at the average earnings level for a work-limited individual of the same characteristics in the March CPS. "Likelihood in 50" is the probability of facing a 50% SSI benefit reduction rate given the distribution of earnings for a work-limited individual of the same characteristics in the March CPS. "Ever SSI" is whether the individual ever received SSI benefits. Standard errors two-way clustered at person and year levels.

*** p<0.01, ** p<0.05, * p<0.1

APPENDIX B

EXAMPLE SOCIAL SECURITY STATEMENT

Prevent identity theft—protect your Social Security number

Your Social Security Statement

www.socialsecurity.gov

Prepared especially for Wanda Worker

May 1, 2012

See inside for your personal information →

WANDA WORKER
456 ANYWHERE AVENUE
MAINTOWN, USA 11111-1111

What's inside…

What Social Security Means To You

This *Social Security Statement* can help you plan for your financial future. It provides estimates of your Social Security benefits under current law and updates your latest reported earnings.

Please read this *Statement* carefully. If you see a mistake, please let us know. That's important because your benefits will be based on our record of your lifetime earnings. We recommend you keep a copy of your *Statement* with your financial records.

Social Security is for people of all ages…
We're more than a retirement program. Social Security also can provide benefits if you become disabled and help support your family after you die.

Work to build a secure future…
Social Security is the largest source of income for most elderly Americans today, but Social Security was never intended to be your only source of income when you retire. You also will need other savings, investments, pensions or retirement accounts to make sure you have enough money to live comfortably when you retire.

Saving and investing wisely are important not only for you and your family, but for the entire country. If you want to learn more about how and why to save, you should visit ***www.mymoney.gov***, a federal government website dedicated to teaching all Americans the basics of financial management.

About Social Security's future…
Social Security is a compact between generations. Since 1935, America has kept the promise of security for its workers and their families. Now, however, the Social Security system is facing serious financial problems, and action is needed soon to make sure the system will be sound when today's younger workers are ready for retirement.

Without changes, in 2033 the Social Security Trust Fund will be able to pay only about 75 cents for each dollar of scheduled benefits.* We need to resolve these issues soon to make sure Social Security continues to provide a foundation of protection for future generations.

Social Security on the Net…
Visit ***www.socialsecurity.gov*** on the Internet to learn more about Social Security. You can read publications, including *When To Start Receiving Retirement Benefits*; use our Retirement Estimator to obtain immediate and personalized estimates of future benefits; and when you're ready to apply for benefits, use our improved online application—It's so easy!

Michael J. Astrue
Commissioner

* These estimates are based on the intermediate assumptions from the Social Security Trustees' Annual Report to the Congress.

Your Estimated Benefits

***Retirement**	You have earned enough credits to qualify for benefits. At your current earnings rate, if you continue working until…	
	your full retirement age (67 years), your payment would be about	$ 1,590 a month
	age 70, your payment would be about	$ 1,983 a month
	age 62, your payment would be about	$ 1,096 a month
***Disability**	You have earned enough credits to qualify for benefits. If you became disabled right now, your payment would be about	$ 1,450 a month
***Family**	If you get retirement or disability benefits, your spouse and children also may qualify for benefits.	
***Survivors**	You have earned enough credits for your family to receive survivors benefits. If you die this year, certain members of your family may qualify for the following benefits:	
	Your child	$ 1,133 a month
	Your spouse who is caring for your child	$ 1,511 a month
	Your spouse, if benefits start at full retirement age	$ 1,477 a month
	Total family benefits cannot be more than	$ 2,782 a month
	Your spouse or minor child may be eligible for a special one-time death benefit of $255.	
Medicare	You have enough credits to qualify for Medicare at age 65. Even if you do not retire at age 65, be sure to contact Social Security three months before your 65th birthday to enroll in Medicare.	

*** Your estimated benefits are based on current law. Congress has made changes to the law in the past and can do so at any time. The law governing benefit amounts may change because, by 2033, the payroll taxes collected will be enough to pay only about 75 percent of scheduled benefits.**

We based your benefit estimates on these facts:

Your date of birth (please verify your name on page 1 and this date of birth)	May 5, 1971
Your estimated taxable earnings per year after 2011	$43,467
Your Social Security number (only the last four digits are shown to help prevent identity theft)	XXX-XX-1234

How Your Benefits Are Estimated

To qualify for benefits, you earn "credits" through your work — up to four each year. This year, for example, you earn one credit for each $1,130 of wages or self-employment income. When you've earned $4,520, you've earned your four credits for the year. Most people need 40 credits, earned over their working lifetime, to receive retirement benefits. For disability and survivors benefits, young people need fewer credits to be eligible.

We checked your records to see whether you have earned enough credits to qualify for benefits. If you haven't earned enough yet to qualify for any type of benefit, we can't give you a benefit estimate now. If you continue to work, we'll give you an estimate when you do qualify.

What we assumed — If you have enough work credits, we estimated your benefit amounts using your average earnings over your working lifetime. For 2012 and later (up to retirement age), we assumed you'll continue to work and make about the same as you did in 2010 or 2011. We also included credits we assumed you earned last year and this year.

Generally, the older you are and the closer you are to retirement, the more accurate the retirement estimates will be because they are based on a longer work history with fewer uncertainties such as earnings fluctuations and future law changes. We encourage you to use our online Retirement Estimator at ***www.socialsecurity.gov/estimator*** to obtain immediate and personalized benefit estimates.

We can't provide your actual benefit amount until you apply for benefits. **And that amount may differ from the estimates stated above because:**

(1) Your earnings may increase or decrease in the future.
(2) After you start receiving benefits, they will be adjusted for cost-of-living increases.
(3) Your estimated benefits are based on current law. **The law governing benefit amounts may change.**
(4) Your benefit amount may be affected by **military service, railroad employment or pensions earned through work on which you did not pay Social Security tax**. Visit ***www.socialsecurity.gov*** to learn more.

Windfall Elimination Provision (WEP) — In the future, if you receive a pension from employment in which you do not pay Social Security taxes, such as some federal, state or local government work, some nonprofit organizations or foreign employment, and you also qualify for your own Social Security retirement or disability benefit, your Social Security benefit may be reduced, but not eliminated, by WEP. The amount of the reduction, if any, depends on your earnings and number of years in jobs in which you paid Social Security taxes, and the year you are age 62 or become disabled. For more information, please see *Windfall Elimination Provision* (Publication No. 05-10045) at ***www.socialsecurity.gov/WEP***.

Government Pension Offset (GPO) — If you receive a pension based on federal, state or local government work in which you did not pay Social Security taxes and you qualify, now or in the future, for Social Security benefits as a current or former spouse, widow or widower, you are likely to be affected by GPO. If GPO applies, your Social Security benefit will be reduced by an amount equal to two-thirds of your government pension, and could be reduced to zero. Even if your benefit is reduced to zero, you will be eligible for Medicare at age 65 on your spouse's record. To learn more, please see *Government Pension Offset* (Publication No. 05-10007) at ***www.socialsecurity.gov/GPO***.

Your Earnings Record

Years You Worked	Your Taxed Social Security Earnings	Your Taxed Medicare Earnings
1987	594	594
1988	1,454	1,454
1989	2,591	2,591
1990	4,366	4,366
1991	5,961	5,961
1992	7,500	7,500
1993	9,055	9,055
1994	11,509	11,509
1995	14,064	14,064
1996	16,545	16,545
1997	19,147	19,147
1998	21,699	21,699
1999	24,363	24,363
2000	27,015	27,015
2001	28,798	28,798
2002	30,079	30,079
2003	31,668	31,668
2004	33,906	33,906
2005	35,897	35,897
2006	38,192	38,192
2007	40,552	40,552
2008	42,127	42,127
2009	41,977	41,977
2010	43,467	43,467
2011	Not yet recorded	

You and your family may be eligible for valuable benefits:

When you die, your family may be eligible to receive survivors benefits.

Social Security may help you if you become disabled—even at a young age.

A young person who has worked and paid Social Security taxes in as few as two years can be eligible for disability benefits.

Social Security credits you earn move with you from job to job throughout your career.

Total Social Security and Medicare taxes paid over your working career through the last year reported on the chart above:

Estimated taxes paid for Social Security:

You paid:	$33,009
Your employers paid:	$33,009

Estimated taxes paid for Medicare:

You paid:	$7,724
Your employers paid:	$7,724

Note: In 2011, you paid 4.2 percent of your salary, up to $106,800, in Social Security taxes and 1.45 percent in Medicare taxes on your entire salary. Your employer paid 6.2 percent in Social Security taxes and 1.45 percent in Medicare taxes for you. If you were self-employed, you paid the combined employee and employer amount of 10.4 percent in Social Security taxes and 2.9 percent in Medicare taxes on your net earnings.

Help Us Keep Your Earnings Record Accurate

You, your employer and Social Security share responsibility for the accuracy of your earnings record. Since you began working, we recorded your reported earnings under your name and Social Security number. We have updated your record each time your employer (or you, if you're self-employed) reported your earnings.

Remember, it's your earnings, not the amount of taxes you paid or the number of credits you've earned, that determine your benefit amount. When we figure that amount, we base it on your average earnings over your lifetime. If our records are wrong, you may not receive all the benefits to which you're entitled.

Review this chart carefully using your own records to make sure our information is correct and that we've recorded each year you worked. You're the only person who can look at the earnings chart and know whether it is complete and correct.

Some or all of your earnings from **last year** may not be shown on your *Statement*. It could be that we still were processing last year's earnings reports when your *Statement* was prepared. Your complete earnings for last year will be shown on next year's *Statement*. **Note:** If you worked for more than one employer during any year, or if you had both earnings and self-employment income, we combined your earnings for the year.

There's a limit on the amount of earnings on which you pay Social Security taxes each year. The limit increases yearly. Earnings above the limit will not appear on your earnings chart as Social Security earnings. (For Medicare taxes, the maximum earnings amount began rising in 1991. Since 1994, **all** of your earnings are taxed for Medicare.)

Call us right away at **1-800-772-1213** (7 a.m.–7 p.m. your local time) if any earnings for years **before last year** are shown incorrectly. Please have your W-2 or tax return for those years available. (If you live outside the U.S., follow the directions at the bottom of page 4.)

Some Facts About Social Security

About Social Security and Medicare…

Social Security pays retirement, disability, family and survivors benefits. Medicare, a separate program run by the Centers for Medicare & Medicaid Services, helps pay for inpatient hospital care, nursing care, doctors' fees, drugs, and other medical services and supplies to people age 65 and older, as well as to people who have been receiving Social Security disability benefits for two years or more. Medicare does not pay for long-term care, so you may want to consider options for private insurance. Your Social Security covered earnings qualify you for both programs. For more information about Medicare, visit ***www.medicare.gov*** or call **1-800-633-4227** (TTY **1-877-486-2048** if you are deaf or hard of hearing).

Retirement — If you were born before 1938, your full retirement age is 65. Because of a 1983 change in the law, the full retirement age will increase gradually to 67 for people born in 1960 and later.

Some people retire before their full retirement age. You can retire as early as 62 and take benefits at a reduced rate. If you work after your full retirement age, you can receive higher benefits because of additional earnings and credits for delayed retirement.

Disability — If you become disabled before full retirement age, you can receive disability benefits after six months if you have:

— enough credits from earnings (depending on your age, you must have earned six to 20 of your credits in the three to 10 years before you became disabled); and
— a physical or mental impairment that's expected to prevent you from doing "substantial" work for a year or more *or* result in death.

If you are filing for disability benefits, please let us know if you are on active military duty or are a recently discharged veteran, so that we can handle your claim more quickly.

Family — If you're eligible for disability or retirement benefits, your current or divorced spouse, minor children or adult children disabled before age 22 also may receive benefits. Each may qualify for up to about 50 percent of your benefit amount.

Survivors — When you die, certain members of your family may be eligible for benefits:

— your spouse age 60 or older (50 or older if disabled, or any age if caring for your children younger than age 16); and
— your children if unmarried and younger than age 18, still in school and younger than 19 years old, or adult children disabled before age 22.

If you are divorced, your ex-spouse could be eligible for a widow's or widower's benefit on your record when you die.

Extra Help with Medicare — If you know someone who is on Medicare and has limited income and resources, extra help is available for prescription drug costs. The extra help can help pay the monthly premiums, annual deductibles and prescription co-payments. To learn more or to apply, visit ***www.socialsecurity.gov*** or call **1-800-772-1213** (TTY **1-800-325-0778**).

Receive benefits and still work...

You can work and still get retirement or survivors benefits. If you're younger than your full retirement age, there are limits on how much you can earn without affecting your benefit amount. When you apply for benefits, we'll tell you what the limits are and whether work would affect your monthly benefits. When you reach full retirement age, the earnings limits no longer apply.

Before you decide to retire...

Carefully consider the advantages and disadvantages of early retirement. If you choose to receive benefits before you reach full retirement age, your monthly benefits will be reduced.

To help you decide the best time to retire, we offer a free publication, *When To Start Receiving Retirement Benefits* (Publication No. 05-10147), that identifies the many factors you should consider before applying. Most people can receive an estimate of their benefit based on their actual Social Security earnings record by going to ***www.socialsecurity.gov/estimator***. You also can calculate future retirement benefits by using the Social Security Benefit Calculators at ***www.socialsecurity.gov***.

Other helpful free publications include:

— *Retirement Benefits* (No. 05-10035)
— *Understanding The Benefits* (No. 05-10024)
— *Your Retirement Benefit: How It Is Figured* (No. 05-10070)
— *Windfall Elimination Provision* (No. 05-10045)
— *Government Pension Offset* (No. 05-10007)
— *Identity Theft And Your Social Security Number* (No. 05-10064)

We also have other leaflets and fact sheets with information about specific topics such as military service, self-employment or foreign employment. You can request Social Security publications at our website, ***www.socialsecurity.gov***, or by calling us at **1-800-772-1213**. Our website has a list of frequently asked questions that may answer questions you have. We have easy-to-use online applications for benefits that can save you a telephone call or a trip to a field office.

You may also qualify for government benefits outside of Social Security. For more information on these benefits, visit ***www.govbenefits.gov***.

If you need more information—Contact any Social Security office, or call us toll-free at **1-800-772-1213**. (If you are deaf or hard of hearing, you may call our TTY number, 1-800-325-0778.) If you have questions about your personal information, you must provide your complete Social Security number. If you are in the United States, you also may write to the Social Security Administration, Office of Earnings Operations, P.O. Box 33026, Baltimore, MD 21290-3026. If you are outside the United States, please write to the Office of International Operations, P.O. Box 17769, Baltimore, MD 21235-7769, USA. You can request a *Statement* at any time.