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The Role of Information in Disability Insurance Application: An Analysis of the Social Security Statement Phase-In[†]

By Philip Armour*

This paper exploits a natural experiment in information provision on US Disability Insurance (DI) applications: the Social Security statement. Although the effect of the statement on DI application was negligible in the general health and retirement study population, among those previously reporting a work limitation, biennial DI application rates approximately doubled. This effect was driven by previously uninformed individuals. Additional analyses show these were new applicants and were no less likely to be accepted onto DI, accounting for a substantial fraction of the rise in DI rolls from 1994 to 2004 and indicating the importance of informational frictions in disability policymaking. (*JEL* D83, G22, H55, J14, J28)

A growing literature in public finance has documented the important role that information, or the lack thereof, can play in behavioral responses to tax and benefit design. In contexts ranging from peer effects in take-up of paternity leave benefits, to local knowledge of the US Earned Income Tax Credit, to intergenerational welfare receipt, to IRS field experiments and student debt, those with greater access to information can be substantially more likely to take up available public benefits (Duflo et al. 2006; Chetty, Friedman, and Saez 2013; Dahl, Løken, and Mogstad 2014; Dahl, Kostøl, and Mogstad 2014; and Bhargava and Manoli 2015). However, the impact of information can be negligible, or even lead to lower take-up, depending on the population, type of information, and program incentives, as other studies, and indeed some of the studies just cited, demonstrate (Jones 2010; Mastrobuoni 2011; Bhargava and Manoli 2015, Seira, Elizondo; and Laguna-Müggenburg 2017). Public finance has long focused on direct economic incentives in optimal policy design, but these findings suggest informational frictions can be

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a strong factor in program participation and can result in individuals leaving a substantial amount of money on the table (Bettinger et al. 2012). These information costs can have heterogeneous effects and interventions intended to alleviate them can have distributional consequences, allowing some subpopulations with weaker social networks and higher informational frictions to "catch-up" to those groups already participating at high levels (Liebman and Luttmer 2012, Hoxby and Turner 2013, Chetty and Saez 2013). For both overall program effectiveness and concerns over inequitable outcomes, these studies point to a strong role for information provision in policy design. However, much of the evidence so far, in particular with regard to social insurance programs, has been largely limited to relatively small field experiments, observational data, or foreign contexts, and it is clear that findings on information provision in one context on one population are not immediately generalizable. This paper provides evidence of how information affects program decision making in a previously unexplored area—disability insurance. The analysis exploits the largest natural experiment in personalized benefit information provision in the United States—the Social Security statement's introduction—and its effect on application and entry onto a large social insurance program: Social Security Disability Insurance.

Social Security Disability Insurance (DI) is the largest disability program in the United States: in 2015, over 10 million individuals received DI benefits, totaling over $124 billion in cash benefits paid out annually. Moreover, the program has been rapidly growing, more than doubling its per capita size since 1984 (SSA 2016). Much of this increase can be attributed to demographic shifts, policy changes regarding eligibility, skill-related economic shocks, and the rise in the Social Security full retirement age. However, this paper, to my knowledge, is the first to look at the role information may have played, as well as which individuals responded to this information in their DI decision making. It does so by exploiting a natural experiment: the phased-in introduction of the Social Security statement, a document which provided information on the suite of Social Security benefits, including current DI coverage status and potential DI benefit amount. The statement began to be automatically sent out to select age groups starting in late 1994, and by 2000, approximately 150 million statements were mailed annually to all workers 25 and older, representing a massive information intervention. Following Mastrobuoni's (2011) analysis of the statement's effect on Social Security retirement benefit knowledge and retirement behavior, I exploit the gradual introduction of the statement by age in the mid-1990s to estimate how DI application decisions change after statement receipt. Specifically, the statement was phased-in by age group: the first age group to receive a statement was all workers 60 and older in fiscal year 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 Table 1 for the timing of the statement's provision).

In contrast to prior information outreach experiments with regard to Social Security and general pension information (Liebman and Luttmer 2012), receipt and recall of the statement was strikingly high: over two-thirds of intended recipients recall receiving and reading it, and 83–90 percent of those who recall receiving one remember its content (Smith and Couch 2014a). However, no previous work

Table 1—Social Security Statement Phase-In Schedule

	SSA fiscal year							
	1994	1995	1996	1997	1998	1999	2000	2001
60 and older		X					X	X
58–60			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

Notes: SSA fiscal years are October of the preceding calendar year to September of the stated year. Statements were sent out three months before individuals' birthday. No statements were automatically sent out before fiscal year 1995, and all individuals with Social Security numbers age 25 and over received a statement from 2000 to 2011.

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 context of DI decision making, despite the statement representing a near-universal provision to eligible individuals of otherwise difficult to obtain personalized information about DI benefits that is of immediate relevance to workers.

Prior research in disability program application decision making suggests that there are many potentially eligible individuals on the margin of DI application, and information as to current benefit eligibility and magnitude may thus be pivotal in the application decision. For example, most individuals wait a significant period of time after experiencing disability onset and application to a disability program, with a mean delay of four years between initial onset and DI application for men (Burkhauser, Butler, and Gumus 2004). Previous work on variation in the generosity of DI, access to health insurance, and interactions with other programs demonstrate the existence of a substantial group of these "conditional applicants" (Autor and Duggan 2003; Rutledge 2012; and Maestas, Mullen, and Strand 2014), who have a qualifying medical disability but apply for DI only under certain conditions. Recent preliminary evidence has also demonstrated the importance of access to application resources, with closures of Social Security offices lowering subsequent local DI application, largely due to congestion at still-open offices, and the facilitation of online DI application increasing application rates, albeit disproportionally toward medically marginal applicants (Deshpande and Li 2017; Foote, Grosz, and Rennane 2017). These new findings are consistent with work on the take-up of other social programs showing the important role of application costs in the likelihood of application (Meyers and Heintze 1999; Currie 2004; Chetty, Friedman, and Saez 2013; and Dahl, Kostøl, and Mogstad 2014).

In this paper, I estimate the impact of being sent a statement on DI application rates for an individual in a given year, using health and retirement study panels matched to Social Security Administration earnings and beneficiary records. These data allow for extensive analysis by preexisting health conditions, prior Social

Security information exposure and knowledge, recent work history, and educational status. 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 intention-to-treat of the statement has a statistically significant and substantial effect on the likelihood of DI application among older workers with prior work-limiting health conditions, amounting to approximately a doubling of the two-year period DI application rate for this group over the sample window.

These effects are large and robust to various specification tests. Event study analyses, permutation tests, sub-analyses by prior knowledge, and separate survey evidence suggest that these statements were highly salient to workers and that behavioral responses started immediately after first statement receipt, driven by those with little prior Social Security knowledge, and continued years after the initial informational exposure, with no evidence of individuals merely shifting forward their application decision. Additionally, the informationally marginal DI applicant (i.e., those applicants who were more likely to apply after receiving a Social Security statement), are no less likely to be accepted into the program than the average applicant among those applying without having received a statement. Point estimates are consistent with the statement increasing the targeting efficiency of DI—the percentage increase in allowed applications was greater than that of denied applications—although this result is not statistically significant. However, the statement did not merely induce medically ineligible individuals to apply. Whether this finding is driven by higher information costs for sicker applicants or an alternative behavioral story is unclear given current data limitations, but I conduct a back-of-the-envelope calculation of the approximate impact of the statement on the overall size of the DI program, finding that 18 percent of the increase in the DI program over the analytic window (1992–2004) can be attributed to the 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] Although outreach to the target population is an important component of any public program, the work disincentives in DI and rarity of return to work among DI beneficiaries, paired with the size of the estimates in this paper, suggest careful study when designing and implementing information provision. 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; Deshpande and Li 2017; and Foote, Grosz, and Rennane 2017), as well as the more general role of information in social program application and take-up (Currie 2004; Bettinger et al. 2012; and Chetty, Friedman, and Saez 2013). By demonstrating the importance of an informational intervention in substantially increasing the size of the DI program, this paper provides a new explanation for part of the large rise in the DI rolls observed in recent decades and emphasizes the

[1] In May 2011, the Social Security Administration stopped automatically sending out a personalized statement to every American over 25 due to budgetary considerations; however, after a Social Security Advisory Board position paper argued for the reintroduction of automatic statement provision, SSA resumed sending out statements as of September 2014.

significant role that the information environment can play in disability program participation decisions.

The rest of the paper proceeds as follows: Section I discusses the relevant features of Disability Insurance; Section II describes the structure of the Social Security statement's phase-in; Section III describes the HRS-SSA matched data; Section IV presents the empirical methodology; Section V describes the results; Section VI estimates the implied effect on the growth in DI rolls; and Section VII concludes. An example statement is available in the online Appendix.

I. Disability Insurance

Social Security Disability Insurance (DI) is the largest federal disability program in the United States with over 10 million current beneficiaries and nearly 9 million disabled workers in 2015.[2] It is part of the Old Age, Survivors, and Disability Insurance (OASDI) social insurance program, commonly referred to as Social Security. However, instead of providing retirement income, DI insures workers' earnings in the event of the onset of a work-limiting health condition and subsequent labor force exit at an age younger than the full retirement age. To qualify, this condition must reduce earnings potential under a substantial gainful activity level, as well as be expected to last at least 12 months or result in death.

The DI program, which accounts for over 15 percent of total payments of the OASDI programs, 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 percent in 1980. By 2011, this fraction had grown to 4.7 percent (Daly, Lucking, and Schwabish 2013). Much of this growth occurred during the 1990s, as shown in absolute terms in Figure 1, with the rise in these rolls as a fraction of working-age adults increasing over 50 percent between 1995 and 2008.

Demographic factors, including the aging of the population, and increasing labor force participation among women leading to greater DI eligibility rates, account for a portion of this trend, but these explanations together can explain only approximately half of the growth in the per capita DI rolls (Duggan and Imberman 2008; Daly, Lucking, and Schwabish 2013). 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 when the American with Disabilities Act was implemented in 1992, program diversion due to the welfare reform of the mid-1990s that shifted some individuals away from Aid to Families with Dependent Children to DI, easing of eligibility standards and the increasing use of vocational factors in disability determination, and a combination of structural changes in the labor market that negatively impacted 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 2008). Depending on the particular estimates one takes from these studies and their interactions, there nevertheless remains a small to a substantial unexplained portion of the recent increase in DI rolls.

[2] Dependents of disabled workers can receive cash DI benefits up to a strict family maximum.

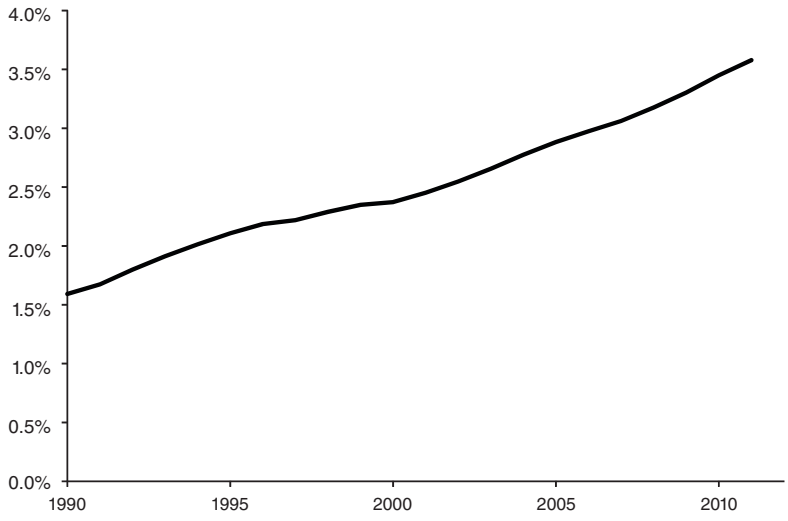

Figure 1. The DI Disabled Worker Rolls as a Percentage of the Working-Age Population, 1990–2011

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

To further understand the explanations for this increase and the potential role therein of the statement, it is necessary to describe the benefit structure of DI. Benefit calculation 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 (i.e., be DI covered), 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 disability onset. 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 significant informational costs in determining his or her OASDI coverage status and potential benefit, with some individuals eligible for DI but not OAI, and others eligible for OAI but not DI.

Medical eligibility is based on both the nature and severity of the impairment as well as resulting earnings capacity. The disability determination process begins with the listings of impairments, which are a set of health conditions for which medical eligibility is presumptively granted. If applicants' conditions are not in the listings of impairments, then their work capacity and extent of medical impairment are evaluated. In order to be eligible, they must be unable to earn above a substantial gainful activity level, set at $1,170 per month for non-blind individuals in 2017. See Burkhauser and Daly (2011) for a full description of the disability determination 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 (QCs) in the most recent 3 years (12 quarters), while a 50-year-old applicant

needs to have earned 20 QCs in the most recent 10 years (40 quarters). In 2017, a QC was allocated for each whole multiple of $1,300 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;[3] 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 to determine eligibility, especially given that coverage is calculated at the date of disability onset, not the current age. 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 observe in the health and retirement study among non-applicants.

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. DI follows the same calculation process as OAI, 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.[4] The average monthly benefit in 2015 was $1,165.79; however, of particular note when considering benefit generosity and replacement rates 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.[5]

Although knowledge about DI benefits among the US population is rarely elicited, Mastrobuoni (2011) reviews health and retirement study (HRS) respondents' 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. However, DI knowledge is not explicitly elicited in the HRS, and despite other work finding that knowledge of the program in general is lower than other components of OASDI (Smith and Couch 2014a), I am not aware of any nationally representative survey eliciting knowledge of respondents' own potential DI eligibility and benefit level.

One's DI coverage status and potential benefit can be learned by either visiting an SSA office during business hours and requesting this information or by visiting SSA's website and signing up for a mySSA account, the former representing a large information acquisition cost, particularly for workers or the medically impaired, while the latter was unavailable over the time period studied here. Therefore, the

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

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

[5] The DI benefit calculation formula at the full retirement age corresponds to the OAI formula. Therefore, at this age, individuals on DI are transferred from DI to OASI automatically and continue to receive the same benefit, while those who did not apply for DI instead face the choice of when to collect their retirement benefits.

automatic and annual 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 2015), distribution of previously difficult to acquire DI information, presented in a clear context from a trusted source, 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. The determination of whether an applicant has a qualifying disability is conducted by state-level gatekeepers (see Maestas, Mullen, and Strand 2013 for a review of the determination process) and is plagued by informational asymmetries. 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-eligible individuals. Much research has concentrated on the prevalence of the former problem—accepting applicants who do not have a qualifying disability—and found that a minority of those accepted onto the rolls would work if not receiving DI benefits, although the prevalence of these potentially work-capable beneficiaries depends on disability type (Bound 1989; Maestas, Mullen, and Strand 2013). However, Benítez-Silva, Buchinsky, and Rust (2004) shows that although approximately 20 percent of applicants accepted onto the rolls do not meet the statutory disability requirements, 60 percent of applicants rejected do meet these requirements. In addition, many of the stages of determination currently have long backlogs; if self-sorting can become more efficient on the DI application margin, these backlogs and overall wait times for eligible individuals can decrease. Since applicants do not work during the application process—otherwise their applications would be rejected—time out of the labor force and any accompanying decay in human capital would be reduced. Although the statement itself does not provide detailed information on the factors under consideration when determining medical eligibility, it is an empirical question as to whether the information revealed tilts the composition of DI applicants toward those more likely to be accepted into the program.

Much of the DI literature, including work on responses to economic shocks, other benefit generosity, timing of condition onset, and the introduction of online applications, has focused on characterizing the marginal DI applicant, finding that there are many more individuals on the margin of DI application than just those who have recently experienced a serious health shock (Autor and Duggan 2003; Burkhauser, Butler, and Gumus 2004; Duggan, Singleton, and Song 2007; and Foote, Grosz, and Rennane 2017). 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 (see Appendix Table B1 for summary statistics on DI applicants versus non-applicants in the HRS). 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 of these facets of DI application behavior is information about the program itself, the focus of this analysis.

II. The Social Security Statement

Starting in 1990, the Social Security Administration began providing preformatted 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 retirement, retirement, spousal, and survivors' benefits.[6] 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. Previous research on the statement finds that 2/3 of individuals who were sent a statement recall receiving one.[7] Of those recalling receipt, the vast majority, 83–90 percent report having read it carefully (see a set of GAO reports[8] and Greenwald et al. 2010). Although corresponding recall statistics for the work-limited or DI-eligible population are unavailable, Mastrobuoni (2011) finds that intention-to-treat statement recipients are more likely to be able to provide an estimate of their Social Security retirement benefits and that these estimated benefits are more likely to be accurate.

Although other research documents extensive heterogeneity in error over future Social Security retirement benefits (Mastrobuoni 2011), to the author's knowledge, no large survey asks participants about their own disability benefits in the event they become disabled. That prior research has demonstrated definite increases in knowledge concerning own retirement benefits, it should be noted that the statement is more informative as to current DI application decision making: for an individual considering applying for DI, the statement reports what that individual's eligible benefit is right now, as opposed to the retirement benefit calculation, which includes projections with assumptions over future earnings paths.

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. 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.[9] Table 1 illustrates which age groups received the statement in which fiscal year, as well as the total number of statements sent out.[10]

[6] Unfortunately, the 2011 cessation of automatic statement distribution was not phased-out, and it was the result of budgetary shortfalls due to the Great Recession itself that would lead an estimate of the effect of stopping statement provision on DI applications to confound this policy change with other shocks and secular trends.

[7] Possible explanations of the remaining third include incorrect addresses, lost mail, never having opened it, or having opened it but forgotten.

[8] T-HEHS-96-210, HEHS-97-19, HEHS-98-228, T-HEHS-00-101, GAO-05-192 on www.gao.gov

[9] 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.

[10] Throughout this paper, I use the terms "statement receipt" and "sent a statement" interchangeably. However, up to one-third of those sent a statement do not recall receiving one; some fraction of these likely did receive one but forgot or did not read it closely, but others may have moved and not had mail forwarded from their address on file with the IRS. Since I do not have any data on whether an individual who was sent a statement actually received one, I use both of these terms for ease of communication in the appropriate context, but they are technically distinct groups.

As evident in Table 1, there is variation by year and age in first statement receipt. To further provide an illustration of the cross-cohort variation in statement receipt timing that I exploit in this analysis, Table 2 shows statement patterns of the 1934–1947 birth cohorts. These cohorts form an illustrative subset of the cohorts in this analysis, and the table indicates the age at which individuals in that birth cohort were sent a statement, if they were sent a statement in that fiscal year. For example, the 1936–1938 birth cohorts received their first statement in 1996, at ages 58–60, while the 1939–1944 cohorts were not sent statements until 1997, when their ages ranged from 53 to 57, and the 1945–1947 birth cohorts received their first statement in 1998, when they were age 51 to 53. Beginning in 2000, the SSA began sending annual statements out to all individuals over the age of 25. As a result of this rollout pattern, there is cross-cohort variation in when individuals first received a statement and their corresponding age of first statement receipt. It is this variation in statement receipt that allows for the identification of the effect of the statement separate from age and year effects. I exploit the fact that otherwise similar cohorts have different statement receipt patterns to identify the causal effect of the statement information on DI application.[11] It is worth noting that this roll-out of the statement was not driven by SSA's perceptions of DI knowledge among these age groups, but instead was intended to allow SSA to build up the capacity to send at least 130 million statements annually, and given the larger size of OAI, older Americans were sent statements first (Smith and Couch 2014b).

There is additional variation in statement receipt arising from the structure of the HRS, which is understated by the cross-cohort statement patterns shown in Tables 1 and 2. The actual timing of the statement mailings depended on one's birth month in the year, with statements being sent out three calendar months before one's birthday each year, so individuals with different birth months in the same birth year are sent statements at different times throughout the year. When this within-cohort variation is combined with variation in the timing of the HRS interview, the result is additional within birth-year variation in statement receipt. For example, if an individual born in 1937 is interviewed before his first statement receipt in 1996, then I can use his labor supply decision in that survey wave as a control observation, in contrast to another individual born in 1937 who, because of some combination of his birth month and interview month I observe after having received a statement. One strength of the data is that it includes information on the month of birth of each respondent, which allows me to closely match the timing of statement receipt with respect to the interview date.

Previous research on this statement has shown that once one controls for age and year, no other factors influence statement receipt (Mastrobuoni 2011), and Appendix Table B2 presents evidence that being sent a statement is uncorrelated with observable characteristics once one controls for age and year fixed effects. By exploiting this natural experiment in Social Security information provision, prior

[11] It is worth noting that eventually all HRS respondents are sent a statement, hence, my variation does not arise from whether individuals ever received statements, but instead when they received their first statement and, in particular, whether they received a statement before reaching the Social Security full retirement age or otherwise leaving the sample, with those receiving statements later acting as the control group for those receiving the statement earlier.

Table 2—Social Security Phase-In, by Birth Cohort and Age at Statement Mailing

	SSA fiscal year							
Birth year	1994	1995	1996	1997	1998	1999	2000	2001
1934		61					66	67
1935		60					65	66
1936			60				64	65
1937			59				63	64
1938			58				62	63
1939				58			61	62
1940				57			60	61
1941				56			59	60
1942				55			58	59
1943				54			57	58
1944				53			56	57
1945					53		55	56
1946					52		54	55
1947					51		53	54

Notes: Ages indicated for SSA fiscal year in which the corresponding birth cohort was sent a statement. Blank space indicates no statement was sent to that birth cohort in that year. See Table 1's notes for more information on the statement's phase-in.

research has shown that after having received these statements, individuals are much more likely to be able to provide any estimate of their Social Security retirement benefits (Biggs 2010, Mastrobuoni 2011). Among those who already provided estimates, the accuracy also improves. However, the statement provides qualitatively different information on retirement benefits (projected benefits based on constant earnings until the claiming ages shown) than disability benefits (the benefit an individual is currently entitled to). The changes in disability application behavior is thus a separate empirical question and is the focus of this paper.

The online Appendix contains an example statement. On page two, 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 65 and 67, depending on birth cohort), and age 70. It also states whether an individual's work experience provides coverage for DI 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 OAI, nor any change in the responsiveness of older Americans to the effect of additional earnings on these retirement benefits (Mastrobuoni 2011).

The statement contains retirement information about only eligibility for OAI and how the benefit differs by one of three claiming ages, but provides no information on how changes in earnings between now and these future dates affect benefits, nor on benefit levels for claiming ages other than those illustrated. As discussed above, the DI benefit level in the statement, however, is the benefit available to individuals *right now*,[12] which is of immediate relevance to a potential DI applicant. Although

[12] 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. Although

the previous research found no average impact on retirement timing, the impact on DI behavior is a distinct empirical question, and it is plausible that the statement's effect on the DI application margin may be stronger, given both a lower awareness of the disability component of OASDI (Smith and Couch 2014a), and the present time frame of the disability information (i.e., current eligibility of DI benefits versus future eligibility of OAI benefits, which can change with future earnings).

III. Data

This paper uses health and retirement study (HRS) panels, matched to Social Security earnings and benefits records. The HRS is a national biennial panel survey of individuals at least age 51 and their spouses; it began in 1992 and refreshed with new 51–56 year-old respondents every 6 years. An extensive data description and detailed variable construction pertinent to this analysis are included in the Data Appendix. 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. Approximately three-quarters of respondents provided permission to match Social Security earnings and benefit records for research purposes,[13] allowing me to focus my analysis on respondents eligible for DI benefits and hence would observe their covered benefit on the statement. I construct these variables for the interview before statement receipt to avoid any possible behavioral responses of statement receipt on DI coverage and benefit, since these values change depending on individual labor supply, which the statement can influence. DI coverage status and potential benefit are thus constant for all within-person years.

Where possible, I use the RAND HRS Version P file, a cleaned and standardized version of a subset of variables from the public-use HRS available publicly on the HRS website and corresponding RAND Fat files for variables not available in the RAND HRS Version P. Notably, 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. My analytic sample uses the person-year (or, more precisely, the person-interview-year) as the unit of analysis, 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, at least 51, are under the full retirement age, have worked enough to be covered by DI, and have not previously applied for DI or SSI. Individuals contribute an observation up until and including the interview year in which they apply for DI or SSI. The binary dependent variable, DI application, is then assigned the value one, and individuals contribute no further observations, since they are no longer at risk of applying for DI. Table 3 shows the

not shown in this paper, I conduct additional placebo tests on the DI *ineligible* population and find no effect of statement receipt on DI application, either for the general population or the work-limited subgroup.

[13] Previous research using these matched data show that for the initial cohort, the matched subset is an unbiased subsample of the full HRS (Kapteyn et al. 2006, Michaud and Van Soest 2008).

Table 3—Sample Construction

Sample selection restriction	Remaining person-years	Unique persons
Non-missing application data	62,948	17,877
Alive	62,267	17,256
Have not previously applied to DI/SSI	54,758	15,022
DI covered and between 51 and 64	41,669	12,113

Source: Health and Retirement Study sample, Waves 1–7

results of the above sample restrictions, with a final count of 41,669 person-years, corresponding to 12,113 unique persons.

In addition to measuring DI application as an outcome variable, I conduct analyses on 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 one only if the person applied for DI since the last interview *and was eventually accepted onto the rolls* and is zero otherwise.

The policy intervention under study is the Social Security statement, which I measure as whether an individual was sent a Social Security statement at any point before the current HRS interview. I refer to this variable as "statement receipt," although I do not have direct evidence in the HRS of individuals receiving a statement, and it is calculated using the rollout depicted in Table 1 and in accordance with monthly-receipt based on three months before birth month in the corresponding fiscal year. For my primary analysis, statement receipt is an absorbing state, whereby once an individual has been sent a statement, this variable is one until he leaves the sample. Since I observe month and year of birth, interview month and year, and DI application month and year, I determine if an individual was sent a statement prior to an interview. However, if an individual both applies for DI and was sent a statement since his last interview, but he applied for DI first, the statement receipt variable is set to zero.

Further, the HRS asks individuals a range of questions relating to disabilities. Of particular note is the construction of the work-limitation variables: the HRS asks all respondents whether they have a health condition that limits the type or extent of work they can do. Unless noted otherwise, I define an individual as being work-limited if they answered yes to this question *in the prior wave*. This lagged measure precludes any justification bias among current DI applicants.

Finally, the two metrics of prior Social Security knowledge I use in my analysis are whether an individual has ever contacted Social Security to prepare a benefit calculation for them (an option available during and before the statement's introduction), which I refer to as "Ever Asked," and whether an individual who is not currently receiving Social Security benefits expects to receive them at some point in the future, which I refer to as "Expects Benefits." Note that since I limit the sample to those who are covered by DI, nearly all respondents are eligible to receive Social Security benefits if disabled or upon reaching age 62, those who report not expecting to receive SSA benefits may be either mistaken about their eligibility, expecting to die before collecting retirement benefits (and consider themselves medically ineligible for DI benefits), or expecting the program itself to cease to exist. Moreover,

the question itself asks about Social Security benefits very broadly, which inserts ambiguity as to what programs an individual may consider to be part of Social Security. Although it is an imperfect measure for being mistaken about OASDI eligibility given these caveats, I nevertheless use it as a proxy for lack of knowledge about own eligibility, given that my analytic sample is overwhelmingly likely to receive Social Security benefits (by 2014, over 90 percent of those in my sample who initially did not expect to receive Social Security benefits reported receiving Social Security income at some point).

I use the "Ever Asked" variable, whether an individual has previously received a benefit calculation from SSA, as one form of a placebo test—these individuals have already received the information contained in the statement from SSA itself, and thus the informational effect of the statement would be correspondingly reduced.

Table 4 provides summary statistics of the 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 reporting a work-limiting condition in the prior interview.

Additionally, Appendix Table B1 provides sample characteristics for the overall sample by whether the respondent applied for DI. From Table 4, a few facts emerge: two-thirds of person-years had been sent a statement over the course of my sample. Slightly over a quarter of the sample has previously contacted Social Security to calculate their retirement benefits, and this number is 37 percent for those who have not received a statement, consistent with statements filling this informational need. Notably, less than half of respondents across these three samples of DI-covered individuals expects to receive Social Security benefits, indicating a large population for whom DI eligibility may be entirely novel information.

One conclusion from these statistics is that those with work-limiting conditions have much lower earnings in their first HRS interview and only slightly lower potential DI benefits, indicating a higher-than-average replacement rate. Also, application for DI is rare among the general population at 2.8 percent, but much higher among those with a work-limitation at 16.3 percent. Since those with work-limitations make up 12.9 percent of the full sample, the clear implication is that the majority of DI applications, 2.1 percent (the product of the application rate among those with a prior work-limitation and the fraction of the full sample with such a work-limitation) of the 2.8 percent total, come from those with prior work-limitations. Given that the weight of DI applications come from this group, the impact of the statement on this subpopulation's behavior will be of particular interest.

IV. Methodology

The primary question I address in this paper is whether a letter sent from SSA that shows individuals their DI coverage status and potential DI benefit, as well as their other Social Security benefits, affects their likelihood of applying for DI. My analysis identifies the intention-to-treat effect of statement receipt on DI application.[14]

[14] I cannot directly observe whether an individual actually received and opened the Social Security statement; however, given the above cited audit studies of statement receipt and that the older population in my study may

Table 4—Descriptive Statistics

	Mean	Standard deviation
Full sample		
Has received a statement	66.6%	47.2%
Male	47.3%	49.9%
Years of education	13.08	2.82
Initial earnings	26,995.69	40,770.47
Initial potential DI benefit	869.25	291.74
Applied for disability	2.8%	16.5%
Accepted onto disability	1.9%	13.5%
Age	57.02	3.74
Any work-limiting condition	12.9%	26.5%
Ever contacted SSA for benefit calculation	27.9%	59.0%
Expects to receive SSA benefits	48.7%	50.0%
Subsample with no statement receipt		
Has received a statement	0	0
Male	47.2%	49.9%
Years of education	12.74	2.86
Initial earnings	25,884.23	39,138.45
Initial potential DI benefit	855.94	291.53
Applied for disability	2.4%	15.2%
Accepted onto disability	1.2%	11.1%
Age	56.23	3.42
Any work-limiting condition	12.8%	33.4%
Ever contacted SSA for benefit calculation	36.9%	63.5%
Expects to receive SSA benefits	45.0%	49.7%
Subsample with work-limiting condition in prior wave		
Has received a statement	64.6%	47.8%
Male	49.7%	50.0%
Years of education	12.57	2.91
Initial earnings	15,594.46	18,394.48
Initial potential DI benefit	798.71	300.34
Applied for disability	16.3%	37.0%
Accepted onto disability	11.1%	31.4%
Age	56.54	3.75
Ever contacted SSA for benefit calculation	24.2%	54.8%
Expects to receive SSA benefits	44.7%	49.7%

Source: Author's calculation, Health and Retirement Study, Waves 1–7

My analytic structure estimates the effect of statement receipt on DI application as measured by the parameter β in the below linear probability model for an individual i of age a in year t:[15]

$$(1) \qquad DI\_application_{iat} = \alpha + \beta Statement_{it} + X_{it}\theta + \delta_a + \rho_t + \epsilon_{iat},$$

where α is a constant, β is the coefficient vector of interest, and $Statement_{it}$ is ever having been sent a Social Security statement; X_{it} is a set of covariates that may vary

be even more likely to reside at a fixed address and to open communications from SSA, the scaling factor from Intent-to-Treat (ITT) to Treatment-on-the-Treated (TOT) is not a substantial multiple. Unfortunately, I know of no audit studies that break out this recall by those with prior health conditions, a population that may also be more likely to take note of letters from the Social Security Administration.

[15] In addition to linear probability model estimates, I estimate logistic regression models and report the corresponding logit marginal effects.

by person-year, including gender, marital status, educational level, race/ethnicity, and drop in the present value of OAI benefits due to the rising full retirement age.[16] I include a set of age a specific dummy variables δ_a and year specific dummy variables ρ_t. All regressions two-way cluster standard errors at the year and birth-year level (Cameron, Gelbach, and Miller 2011), the level of treatment given the variation in the statement's introduction, or in the case of the logit models, at the year-birth-year interaction level. I further estimate variants of equation (1) that interact selected individual characteristics (e.g., educational attainment) with the statement variable $Statement_{it}$, reflecting heterogeneous subgroup effects.

Because of the phase-in structure of the statement, equation (1) estimates the average effect of post-statement receipt when controlling for the above covariates and including 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 by these fixed effect coefficients and not the coefficient on statement receipt. 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 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-differences structure means that if there are any cohort-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 or DI eligibility changes disproportionately affecting different ages (an example of such a change would be increasing reliance on vocational factors in DI eligibility requirements concentrated among those above a certain age), I estimate additional specifications controlling for cohort-specific linear time trends, where each individuals birth-year is given by δ_i.[17] The only remaining factors that may bias the statement receipt coefficient would be those almost exactly following the statement phase-in schedule. I estimate these linear time trends according to the following specification for an individual i of birth-cohort c in year t:

$$(2) \qquad DI\_application_{ict} = \alpha + \beta Statement_{it} + X_{it}\theta + \delta_c + \gamma_c t \delta_c + \epsilon_{ict}.$$

Subsequent specifications also include statement interaction terms with work-limited status, previous employment, other disability conditions, and potential DI benefit interaction terms.

[16] This decline in present value is calculated using the methodology employed in Duggan, Singleton, and Song (2007), since during this time period, the rise in the full 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, Singleton, and Song 2007; Li and Maestas 2008).

[17] Additional specifications with five-year age-group-specific year dummy variables, staggered around the statement recipient age groups, provide nearly identical results and are available upon request.

Equations (1) and (2) both contain an important assumption of the role of information on DI application decision making—that the statement's effect is immediate and constant. This assumption is based on Mastrobuoni's (2011) analysis and is common to most difference-in-differences approaches, and although it allows for straightforward extrapolation of the results to trends in the DI rolls, it is directly testable by estimating an event study model via equation (3):

$$(3)\quad DI\_application_{iat} = \alpha + \sum_{w=-3}^{-2} \beta_w 1(t - t_S^* = w) + \sum_{w=0}^{3} \beta_w 1(t - t_S^* = w) + X_{it}\theta + \delta_a + \rho_t + \epsilon_{at},$$

wherein a separate coefficient is estimated for each wave around statement receipt, excluding the wave immediately prior to first statement receipt ($w = -1$). This event study analysis relaxes the assumption of a common effect and allows for testing the assumption of common prior trends.

V. Results

A. *Main Analysis*

The statement reveals to individuals the monthly disabled benefit they are currently entitled to given their work history. However, the timing, magnitude, and even the sign of the effect are all empirical questions: depending on preexisting knowledge and the structure of disability application decision making, both of which are unobservable in the HRS, the statement's effect on DI application and entry will differ. For example, for individuals with full knowledge of their eligibility for DI with benefit expectations higher than the actual benefit, or for individuals who are ineligible for the program, receiving the statement may decrease their likelihood of application. Alternatively, it is difficult to imagine individuals who have no knowledge of potential DI eligibility having a lower likelihood of DI application after receiving information as to the program's existence and their eligibility.

To graphically examine these effects, Figures 2 and 3 plot estimates of wave dummies surrounding first statement receipt from equation (3), with DI application and DI entry as the dependent variables and including linear probability model difference-in-differences estimates from columns 2 and 4 of Table 5. Figure 2 shows this event study graph for the full sample, and Figure 3 restricts the analysis to individuals reporting a work-limiting health condition in the prior wave. The x-axis tracks HRS waves around the interview wave by which an individual was sent a statement; each wave corresponds to approximately two years, depending on the exact interview dates. These event study analyses suggest an immediate, persistent, and generally constant effect, as well as showing similar prior trends (the p-value of a joint significance test of the -3 and -2 coefficients is 0.86 for the full sample and 0.91 for the work-limited subsample). Furthermore, the consistency of estimates across year fixed effects and linear time trend controls also suggests that this condition of prior trends across treatment and control groups is not violated.

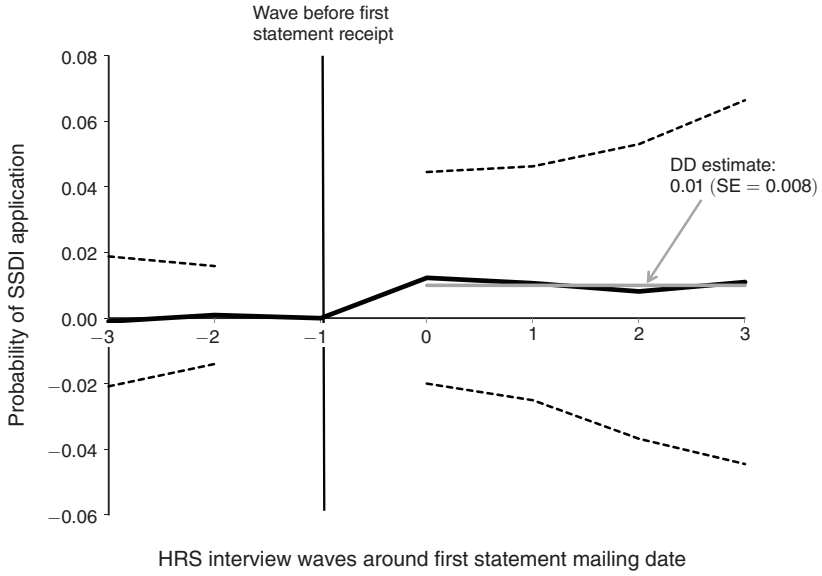

Figure 2. Regression-Adjusted Estimates of Statement Receipt on SSDI Application, Full Sample

Notes: Wave dummies from estimating equation (3). Ninety-five percent confidence interval lines and coefficient estimates from Table 5 shown. Standard errors are two-way clustered at year and birth-year level.

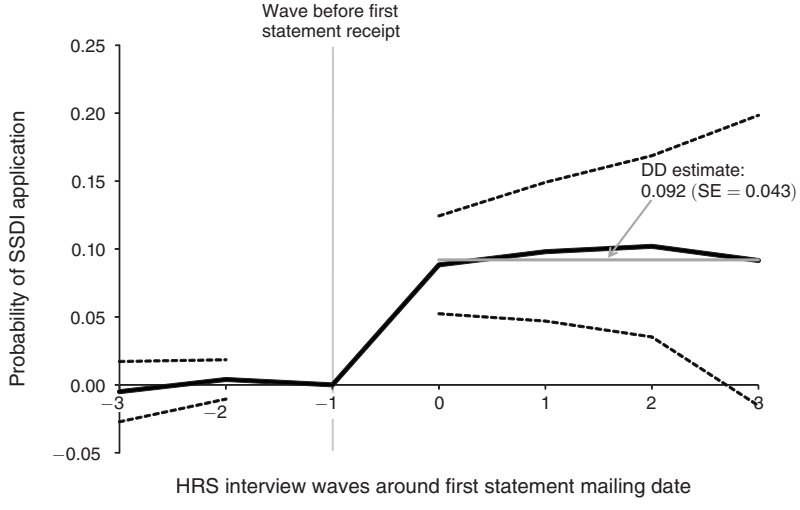

Figure 3. Regression-Adjusted Estimates of Statement Receipt on SSDI Application, Sample with Work-Limitation in Prior Wave

Notes: Wave dummies from estimating equation (3). Ninety-five percent confidence interval lines and coefficient estimates from Table 5 shown. Standard errors are two-way clustered at year and birth-year level.

For both the overall sample and the work-limited subsample, the likelihood of DI application rises immediately after having been sent a statement, although these wave-specific estimates are statistically significant for only the work-limited

Table 5—Effect of Statement Receipt on DI Application, by Age and Year Controls, Full and Previously Work-Limited Samples, Linear Probability Coefficients, and Logit Marginal Effects

	DI application			
	Full		Work-limited	
Linear probability model	(1)	(2)	(3)	(4)
Statement	0.020	0.010	0.120	0.092
	(0.010)	(0.008)	(0.051)	(0.043)
Cohort permutation test *p*-value	0.0664	0.1796	0.0006	0.0016
Individual permutation test *p*-value	0.0472	0.1532	0.0002	0.0006
Separate age and year dummies	Yes	No	Yes	No
Cohort-specific linear time trends	No	Yes	No	Yes
DI covered only	Yes	Yes	Yes	Yes
Person-years	41,669	41,669	4,882	4,882
R^2	0.027	0.025	0.157	0.154
logit marginal effects				
Statement	0.008	0.004	0.139	0.081
	(0.006)	(0.005)	(0.054)	(0.033)
Cohort permutation test *p*-value	0.2112	0.2398	0.0010	0.0023
Individual permutation test *p*-value	0.1366	0.1507	0.0002	0.0008
Separate age and year dummies	Yes	No	Yes	No
Cohort-specific linear time trends	No	Yes	No	Yes
DI covered only	Yes	Yes	Yes	Yes
Person-years	41,669	41,669	4,882	4,882
Pseudo R^2	0.061	0.057	0.173	0.164
No-statement DI application mean	0.024	0.024	0.127	0.127

Notes: Linear probability regression and logit (weighted) using individuals 51–64 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 HRS interview. All regressions control for gender, educational attainment, race/ethnicity, marital status, and reduction in OAI benefits due to rising full retirement age. Sample limited to living, DI covered individuals, age 51 to 64. Robust standard errors are in parentheses, two-way clustered at the year and birth-year levels or at the year × birth-year interacted level for logits.

subsample for the first four years (i.e., two waves) after initial receipt. The magnitude of the increase is also substantially higher for those previously reporting a work-limiting health condition.

As I discussed in the statement section, the variation in the HRS includes both across-wave variation, as well as within-wave variation depending on the monthly timing of statement receipt and interview date. I aggregate my event study measures to the wave level for two reasons: first, monthly application rates are substantially noisier than two-year elapsed application rates, limiting power; and second, and most importantly, the current specification relies on self-reported disability application since the last interview; whereas a monthly measure relies on respondents accurately recalling the exact month of application, introducing substantial measurement error and further limiting power. Although the HRS match to Social Security records

includes a match to Form 831 DI records, which contain exact month and year of filing for DI, these records are limited to those who remained in the HRS sample after their application to DI and continue to provide permission to match SSA records, representing a smaller and skewed sample. I nevertheless provide the corresponding month-level event study analyses using these Form 831 records for the overall population and work-limited population in Appendix Figures A1 and A2, indicating a similar pattern of common prior trends and an immediate and persistent increase in DI application after being sent a statement.

This initial graphical evidence suggests a persistent increase in DI application rates driven by the work-limited population, with this increase occurring directly after first statement receipt. I next provide estimates of equations (1) and (2).

Table 5 reports these statement treatment effect estimates as both coefficients from a linear probability model (LPM) specifications, as well as marginal effects from a logit specification. Although the effect on the overall population, ranging from 0.4 to 2.0 percentage points, is large relative to the mean DI application rate of 2.4 percent, these coefficients are not precisely estimated and marginally statistically significant only in column 1, the LPM specification.[18] However, when the equation is estimated on the population previously reporting a work-limitation, all the estimated treatment effects are large and statistically significant, ranging from 8.1 to 13.9 percentage points, relative to a mean DI application rate in this population of 12.7 percent. These are large increases in the likelihood of application (approximately a doubling of the baseline rate), among those previously reporting a health condition that limits the type or extent of work they can do.[19] In as much as past research has shown that this measure in the HRS is an unbiased proxy for SSA's definition of disability (Benítez-Silva et al. 2004), this increase in applications is concentrated among the target population for DI.

Further, I report *p*-values derived from two different permutation tests, based on estimating equations (1) and (2) with randomized statement receipt: the "Individual permutation test *p*-value" is the result of comparing our estimate based on the true statement phase-in schedule to one in which statement receipt is randomized at the individual level, preserving the mean overall first statement receipt level, as well as the structure of information receipt, wherein once one has been sent a statement, the statement receipt variable is one until the individual leaves the sample (i.e., it continues to be an "ever received" measure). The "Cohort permutation test *p*-value" randomizes according to the age-by-year categories described in Table 1, with each trial being a different arrangement of *X*s in this grid, and again preserving the structure of the statement variable as an "ever received" measure. I run 10,000 trials of each randomization scheme. The *p*-values reported are the fraction of trials with an estimated statement coefficient greater than the "true phase-in" estimated

[18] Appendix Table B8 provides estimates for the LPM with cohort-specific time trends with different cluster levels to provide insight as to the dependence of significance levels on the two-way cluster choice; given other alternatives, this choice of clustering provides the most conservative estimate of standard errors, but there are not notable differences in significance levels.

[19] Although not shown, the coefficient estimate of the effect of statement receipt on DI application for those not previously reporting a work-limitation is an imprecisely estimated zero across all specifications. Further specifications redefining work-limitation at the time of first HRS interview provide similar estimates and are available upon request.

coefficient. These *p*-values are consistent with the standard errors estimated in the main specification, indicating the estimated coefficient is highly dependent on the exact statement phase-in. Any deviation in this phase-in schedule, either at the individual or cohort level, attenuates the results, supporting the claim that the statement variable is not proxying for unobservable heterogeneity or omitted variables.

The welfare consequences of induced DI application varies depending on the outcome of the application; if these applicants are all denied benefits, then the increased application rate represents additional administrative costs to the disability determination system, and any time spent not working due to the DI application process depresses earnings potential of these applicants (Autor et al. 2011). Table 6 reports coefficient estimates corresponding to DI entry (application and eventual acceptance) as opposed to just DI application. If these estimates were identical to the application coefficients in Table 5, then each induced applicant was accepted into DI. If instead they were all zero, then none of these applicants were ever accepted. As Table 6 demonstrates, the estimates lie in between these extremes.

Using the baseline application and entry rates and the estimates from Tables 5 and 6, I can compare the fraction of applicants who were accepted without having received a statement to among those who have; 50 percent of prior work-limited applicants were accepted before the statement, whereas after statement receipt, 52 percent of work-limited applicants are accepted. That is, these informationally marginal applicants are no less likely to be accepted into the program; if anything, they are slightly more likely to be determined as disabled, albeit not statistically significantly so. Not shown due to space constraints but available upon request, a multinomial logit specification with three outcomes—no current DI application, DI application and eventual rejection, and DI application and eventual acceptance—provide estimated odds ratios of the impact of statement receipt of 1.87 for unsuccessful application and 2.58 of successful application among the previously work-limited population. Given the Deshpande and Li (2017) model of DI targeting wherein targeting efficiency improves if the percentage increase in successful applications is greater than the percentage increase in unsuccessful applications, this higher percentage increase in successful applications indicates improved targeting efficiency. However, a Wald test cannot reject that these estimated odds ratios are the same, so although these point estimates indicate improved targeting efficiency, I can infer only that these informationally marginal DI applicants are not statistically less likely to be accepted into the program.

The event study analysis indicated a marked increase in DI application rates directly and persistently after statement receipt for the previously work-limited, and permutation tests show these estimates are driven by the statement pattern itself; however, the effect sizes estimated above are quite large. To further validate these results and understand what factors drive this reaction, I provide separate application and entry estimates by prior knowledge of Social Security benefits, the plausible mechanism for the statement's effect. Table 7 reports these estimates with regard to DI application.

As shown in columns 1 and 2 of Table 7, for those individuals who expect to receive Social Security benefits, the effect of the statement itself is dramatically smaller. Indeed, the linear combination of the statement and "Expects Benefit × Statement"

Table 6—Effect of Statement Receipt on DI Entry, by Age and Year Controls, Full and Previously Work-Limited Samples, Linear Probability Coefficients, and Logit Marginal Effects

	DI entry			
	Full		Work-limited	
Linear probability model	(1)	(2)	(3)	(4)
Statement	0.012	0.008	0.064	0.060
	(0.007)	(0.006)	(0.035)	(0.033)
Separate age and year dummies	Yes	No	Yes	No
Cohort-specific linear time trends	No	Yes	No	Yes
DI covered only	Yes	Yes	Yes	Yes
Person-years	41,669	41,669	4,882	4,882
R^2	0.017	0.016	0.109	0.103
logit marginal effects				
Statement	0.004	0.007	0.100	0.069
	(0.003)	(0.004)	(0.040)	(0.029)
Separate age and year dummies	Yes	No	Yes	No
Cohort-specific linear time trends	No	Yes	No	Yes
DI covered only	Yes	Yes	Yes	Yes
Person-years	41,669	41,669	4,882	4,882
Pseudo R^2	0.061	0.063	0.136	0.111
No-statement DI entry mean	0.009	0.009	0.064	0.064

Notes: Linear probability regression and logit (weighted) using individuals 51–64 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 and was eventually accepted into the program. 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 HRS interview. All regressions control for gender, educational attainment, race/ethnicity, marital status, and reduction in OAI benefits due to rising full retirement age. Sample limited to living, DI covered individuals, age 51 to 64. Robust standard errors are in parentheses, two-way clustered at the year and birth-year levels or at the year × birth-year interacted level for logits.

variables is not statistically significantly different from zero. Although this question elicits a response to Social Security benefits in general, which could be interpreted as just retirement benefits, these results are consistent with the statement effect on DI application acting through a mechanism of revelation of eligibility for *any* personal DI benefit.

As a further placebo test, columns 3 and 4 of Table 7 include 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), which I code to 1 if the respondent answers affirmatively to this question prior to statement receipt. Although the question does not ask 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, consistent with the statement's estimated effect arising from its information content, prior knowledge about personalized OASDI benefits attenuates the effect of statement receipt; the linear combination of the "Ever Asked × Statement" variable with the overall statement effect is not statistically significantly different from zero.

TABLE 7—EFFECT OF STATEMENT RECEIPT ON DI APPLICATION AND ENTRY BY PRIOR KNOWLEDGE, AMONG PREVIOUSLY WORK-LIMITED RESPONDENTS, LINEAR PROBABILITY COEFFICIENTS

	DI application				DI entry			
	Work limited				Work limited			
Linear probability model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Statement	0.202	0.156	0.153	0.140	0.195	0.211	0.121	0.135
	(0.055)	(0.083)	(0.037)	(0.039)	(0.054)	(0.063)	(0.032)	(0.043)
Expects benefits	−0.030	−0.029			0.004	−0.001		
	(0.016)	(0.017)			(0.017)	(0.019)		
Expects benefits × statement	−0.128	−0.128			−0.172	−0.168		
	(0.045)	(0.041)			(0.053)	(0.053)		
Ever asked			0.040	0.030			0.036	0.030
			(0.018)	(0.018)			(0.013)	(0.013)
Ever asked × statement			−0.109	−0.092			−0.095	−0.086
			(0.031)	(0.027)			(0.027)	(0.023)
Separate age and year dummies	Yes	No	Yes	No	Yes	No	Yes	No
Cohort-specific linear time trends	No	Yes	No	Yes	No	Yes	No	Yes
DI covered only	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Person-years	4,882	4,882	4,882	4,882	4,882	4,882	4,882	4,882
R^2	0.156	0.135	0.134	0.135	0.131	0.134	0.096	0.098

Notes: Linear probability regression (weighted) using individuals 51–64 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 HRS interview. "Ever Asked" variable corresponds to whether respondent answered that they had at some point contacted SSA for personalized retirement benefit information prior to statement receipt. "Expects benefits" is an indicator for whether the respondent expects to collect any type of Social Security benefit in the future. All regressions control for gender, educational attainment, race/ethnicity, marital status, and reduction in OAI benefits due to rising full retirement age. Sample limited to living, DI covered individuals, age 51 to 64. Robust standard errors are in parentheses, two-way clustered at the year and birth-year levels.

There are similar patterns for the DI entry outcome, in columns 5 through 8 of Table 7, and indeed, it appears that the average entrance effects masked even more hetereogeneity in effect, with those whose statement would reveal their benefit entitlement much more likely to apply and enter DI. This sub-analysis directly addresses the concern that the coefficient estimates in Tables 5 and 6 are measuring an effect other than the statement, since this effect disappears or is strongly attenuated among those for whom there is no novel information content in the statement.[20]

Although not shown in the main body of this paper due to space constraints, I provide subgroup estimates in the Appendix by prior work and educational attainment, type of disabling health status, potential DI benefit, and census division (shown in Appendix Tables B4, B5, B6, and B7). From both Appendix Tables B4 and B5, it is clear that the statement's effect on DI application was not via inducing relatively healthy individuals with high earnings capacity to apply to DI. Instead, the statement's effect was strongest among the work-limited population, those with low educational attainment, and those with limitations to day-to-day activities, and it

[20] Unfortunately, in-person interviews or focus groups to determine whether statement recipients consciously took note of their DI benefit information and applied to DI accordingly are difficult given the two-decade time gap between now and the statement's introduction. However, research is in progress to carry out such surveys amidst the statement's current reintroduction.

was no higher among those previously working. It does not appear that the statement induced individuals with "marginal" or low-mortality disabling conditions, such as musculoskeletal or non-retardation mental disorders (Autor and Duggan 2006; Maestas, Mullen, and Strand 2013), to disproportionately apply relative to those with otherwise similar functional impairments. These findings are consistent with an improvement, or at least a lack of worsening, in DI targeting efficiency; that is, those applying to DI after statement receipt are no less likely than the average DI applicant to be accepted into the program, and, indeed, point estimates indicate they are slightly more likely to be determined as disabled.

With regard to potential DI benefit, the strongest statement effects are at the bottom and middle of the benefit distribution. Although those with higher benefits may be surprised by the size of the monthly payment they are eligible for, these individuals have higher lifetime earnings (hence the higher benefit) and a lower earnings replacement rate due to the progressive nature of the DI benefit calculation formula. Those further down the benefit distribution have both mechanically higher replacement rates, as well as likely less remunerative labor market opportunities.

Similarly, as shown in Appendix Table B7, the statement's effect is particularly strong in the Middle Atlantic, the East South Central, and the West South Central census divisions, which are areas with higher DI enrollment and DI replacement rates (Autor and Duggan 2003). However, the question arises as to whether these individuals applying after receiving a statement, who appear to be similar to the average DI applicant, represent new applicants or individuals who would have applied to the program eventually.

B. *Evidence of Shifting Forward of Eventual Applicants*

A concern for interpreting the magnitude of the estimated effect of the statement, and any policy conclusions resulting therefrom, is the possibility that the estimates of statement-induced applicants reported above do not represent new applicants, but merely eventual applicants who are now applying earlier than they would otherwise. Such a behavioral response would still indicate the importance of information costs in DI application, and the statement's role in reducing these costs, but the overall impact on the program's size would be reduced.

If these induced applicants would have applied later anyway, then as individuals exited the sample due to statement-induced DI application, the remaining pool would be less likely to apply for DI, since their applicants have already applied. One test of this hypothesis is to include a trend effect interacted with statement receipt; if the shifting forward story is true, then the effect of the statement should trend strongly downward as all the eventual DI applicants leave the sample.

Table 8 shows that although there is a slight negative trend in years since having received a statement, this trend is quite small and statistically insignificant and is consistent with the event study evidence that the effect remains persistently high.[21]

[21] Additional unreported analyses with dummy variables for each year after statement receipt further show no statistically significant effects, nor are the point estimates large enough to lead to statistically significantly different effect sizes relative to the main effect.

Table 8—Effect of Statement Receipt on DI Application by Years since Statement, by Previous Work-Limitation, Linear Probability Coefficients

	DI application			
	Full		Work-limited	
	(1)	(2)	(3)	(4)
Statement receipt	0.021	0.011	0.122	0.101
	(0.010)	(0.008)	(0.053)	(0.040)
Years since statement	−0.001	−0.001	−0.008	−0.009
	(0.002)	(0.002)	(0.012)	(0.012)
Separate age and year dummies	Yes	No	Yes	No
Cohort-specific linear time trends	No	Yes	No	Yes
Fully insured only	Yes	Yes	Yes	Yes
Person-years	41,669	41,669	4,882	4,882
R^2	0.018	0.017	0.146	0.131

Notes: Linear probability regression (weighted) using individuals 51–64 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 HRS interview. All regressions control for gender, educational attainment, race/ethnicity, marital status, and reduction in OAI benefits due to rising full retirement age. Sample limited to living, DI covered individuals, age 51 to 64. Robust standard errors are in parentheses, two-way clustered at the year and birth-year levels.

As such, the vast majority of the DI application effect observed appears to be individuals who otherwise would wait to collect Social Security retirement benefits, but once they have been informed of their eligibility for DI benefits, apply for them and are no less likely to enter the program.[22] One plausible explanation for the lack of shifting-forward is the recent-work requirement in DI: if individuals have not worked five of the past ten years before the onset of their disability, they will no longer qualify for DI benefits. Although their actual onset date is independent of when they choose to apply for DI (individuals are free to allege any onset date before application), establishing this onset date requires detailed and convincing medical records, and the longer an individual waits before application, the more difficult it may be to prove that their onset occurred while still DI eligible. Hence, the statement's effect may act as both a spur to apply immediately, when waiting may render a higher burden of proof (and a greater likelihood of a denial based on no longer satisfying the recent-work requirement), as well as a document showing that an individual was eligible at a point in time after onset, leading them to allege this earlier onset date in their eventual DI application. One narrative consistent with the findings in this analysis is that the statement acts as an inducement to apply for those

[22] 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 five to ten years earlier when previously one would only have been on the rolls for one to five years represents a large increase in the time spent on the rolls and the total benefits received.

on the margin of losing eligibility/facing higher verification requirements, instead of for those who already plan to apply at some point in the future.

VI. Implied Effect on DI Rolls

The analysis above identified an increase in the likelihood of DI application among the work-limited population 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 merely to provide a context for how the above estimated effect sizes compare to general secular increases in the DI rolls.

The method for calculating what fraction of the increase in the DI rolls can be attributed to the statement takes six steps:

(i) Start with the 51- to 64-year-old population from 1994 to 2004, estimated from the Current Population Survey.

(ii) Calculate the number of recipients of statements in each year for these ages given the statement's rollout pattern.

(iii) Exclude the fraction of those not covered by DI and those not reporting a work-limiting health condition using population averages from the HRS.

(iv) To estimate the number of new entrants, apply the additional average two-year percentage point increase in DI entry of 6.9 percentage points from the logit marginal effect in column 4 of Table 6 to this fraction of DI covered, work-limited statement recipients.

(v) Subtract out the fraction each year that exits the DI program, due to aging onto OAI, death, or medical recovery, based on their age and population averages from the Annual Statistical Report on the Social Security Disability Insurance program (SSA 2016).

(vi) Sum these annual net gains to arrive at an estimate of the stock in 2004 of new entrants due to statement receipt.

I emphasize once again that this approach is to provide a general context for the size of the statement's potential effect. There are a number of strong assumptions necessary: the non-work-limited do not reduce their likelihood of application,[23] and

[23] Although not shown, separate analyses with the nonwork-limited population find near-zero estimates that are imprecisely estimated.

there are no aggregate changes in the behavior of individuals under 51.[24] I implicitly assume in the above calculation that the overall effect was entirely due to new applicants. However, if shifting forward accounts for an important component of that overall effect, my estimated increase in entrants still has first-order effects on the size of the DI rolls, since these individuals will be on the DI rolls for a substantially larger fraction of their 50s and 60s. Future research using large administrative data may uncover any aggregate effect that allows for a more rigorous methodology of estimating the increase in DI rolls attributable to the statement; however, even in the absence of an aggregate effect, the subgroup heterogeneity and information mechanisms identified above show the importance of the statement as a policy instrument.

Executing the 6 steps above leads to an estimate of 413,000 of the 6,197,000 disabled worker beneficiaries in 2004 being induced to enter the program due to statement receipt, which is about 7 percent of the beneficiary population (given the standard error of 0.029 on the estimated marginal effect of 0.069, the resulting 95 percent confidence interval for this estimate is [1.2 percent, 12.7 percent]). Between 1994 and 2004, the DI disabled worker rolls grew by over 2.2 million beneficiaries; these 413,000 new beneficiaries thus represent 18 percent of this growth (95 percent CI: [3.2 percent, 33.4 percent]). Given the caveats pointed out above, this actual number may be lower or higher, but this calculation indicates that the statement may be responsible for a non-negligible fraction of the growth in DI rolls. To place this figure in context, Duggan and Imberman (2008) estimates that between 1984 and 2004, economic conditions alone account for 12 percent and 24 percent of the growth in DI rolls for women and men, and increasing replacement rates account for 28 percent and 24 percent of the growth for women and men, suggesting that the statement had a similarly sized impact on the DI rolls, and although it was not primarily responsible for the rise in these rolls over the past 35 years, my estimates imply it contributed to it.

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, a non-negligible fraction 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.

VII. Discussion and Conclusion

In this paper, I analyze the effect of revealing personalized DI benefit information on DI application and entrance rates among older workers using health and retirement study panels matched to administrative Social Security records. My analysis exploits variation in information provision arising from the staggered introduction of the Social Security statement in the late 1990s. A central finding of this analysis is

[24] Although analyses using the under-51 spouses of HRS respondents find no statistically significant effect of the statement, this population is highly select.

that although the overall effect of the statement on DI behavior was small and noisy, this information provision significantly and substantially increased DI application rates among the older work-limited population. Moreover, these applicants who previously reported a work-limiting health condition and applied for DI after receiving a statement are no less likely to be accepted onto the DI rolls than non-statement applicants.

Unlike previous work finding no average impact of the statement on Social Security Old Age Insurance decision making (Mastrobuoni 2011), I focus on Disability Insurance behavior instead of retirement timing, for which the statement provides immediately relevant information for a lesser known program among statement recipients (Smith and Couch 2014a). Indeed, the effect is strongest among those who do not expect to collect any Social Security benefits and is attenuated among those who previously asked Social Security to calculate their suite of benefits, consistent with the revelation of benefit eligibility acting as the driving mechanism of the estimated effect. To my knowledge there has been no previous research studying the role of information in the US DI application decision and no research testing the effects of a large information intervention on DI decision making in any country. However, this analysis is consistent with findings from recent work establishing the importance and policy relevance of changing DI application costs (Deshpande and Li 2017; Foote, Grosz, and Rennane 2017). This paper further contributes to the broader 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 of the average effect of statement receipt on DI application had certain limitations: the possibility of individuals shifting forward their application decisions, the use of self-reported application 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 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. An event study analysis using a subsample with matched administrative application data finds largely consistent effects as the broader self-reported analysis. However, I do not estimate how statement receipt affects the general adult population's DI behavior, and whether the strong effect of statement receipt among the work-limited population is systematically different for younger workers is an avenue for future research, although the lower rates of work-limitation and DI receipt among younger Americans suggests the effect would likely be less relevant for this population.

My estimates imply that these statement-induced entrants onto the DI rolls can account for approximately 18 percent of the rise in per capita DI rolls from 1994 to 2004. Consistent with previous work on the EITC and various social programs, I find that personalized information about program eligibility and benefit levels from official or trusted sources can have a large effect on application behavior. However, like many of the papers in this literature, the effect of information provision is highly dependent on the population, decision margin, and type of information conveyed. That the effect found in this paper is driven by those with lower educational

attainment and worse health—those for whom DI is especially generous—shows that informational costs can be quite strong, particularly among programs' target populations, for US disability programs. The statement's strong effect on DI application and entrance for the work-limited population, and the resulting size of the program, suggests the need for careful design of information interventions pertaining to benefit eligibility. This study joins other recent research in finding that official communications or program knowledge diffusion can have strong effects on application behavior, and that information interventions can act as an important policy lever for public programs in general.

Appendix Figures

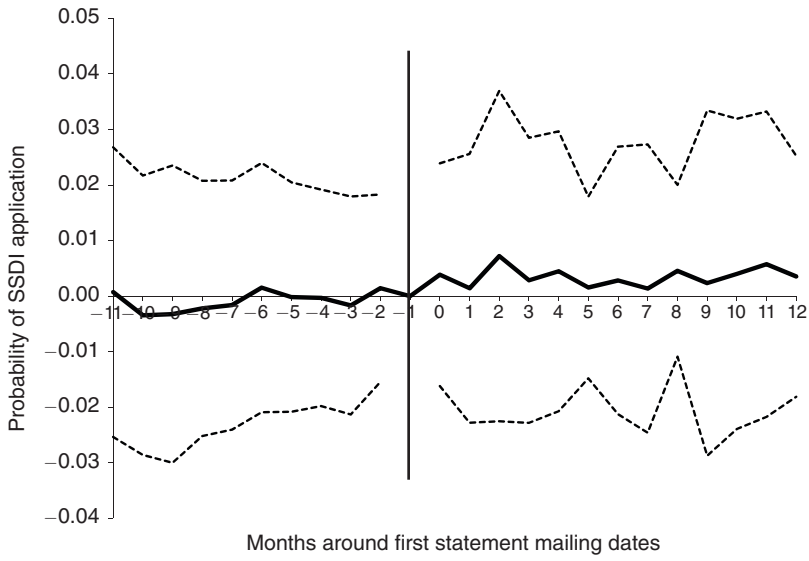

Figure A1. Regression-Adjusted Estimates of Statement Receipt on SSDI Application, Full Sample, Monthly Level, Matched 831 Records

Notes: Wave dummies are from estimating equation (3) at monthly event-time level, with subsample matched to Form 831 SSA records. Ninety-five percent confidence interval lines shown. Standard errors are two-way clustered at year and birth-year level. Corresponding two-year marginal effect from estimating equation (2) with subsample with matched Form 831 DI application data is 0.009 (SE 0.009), Observations = 17,835.

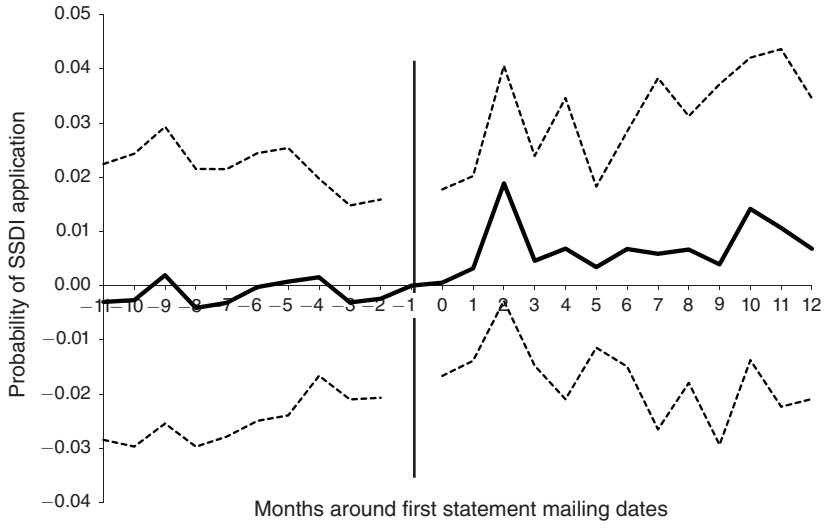

FIGURE A2. REGRESSION-ADJUSTED ESTIMATES OF STATEMENT RECEIPT ON SSDI APPLICATION, BASELINE WORK-LIMITED SAMPLE, MONTHLY LEVEL, MATCHED 831 RECORDS

Notes: Wave dummies are from estimating equation (3) at monthly event-time level, with subsample matched to Form 831 SSA records, further limited to those reporting a work-limiting health condition in their first health and retirement study interview. Ninety-five percent confidence interval lines are shown. Standard errors are two-way clustered at year and birth-year level. Corresponding two-year marginal effect from estimating equation (2) with subsample with matched Form 831 DI application data is 0.094 (SE 0.069), Observations = 2,001.

APPENDIX TABLES

TABLE B1—DEMOGRAPHIC CHARACTERISTICS, BY HAVING APPLIED FOR SOCIAL SECURITY DISABILITY INSURANCE

	Has not applied for DI	Applied for DI
First receipt	0.66	0.72
	(0.47)	(0.45)
Female	0.47	0.46
	(0.50)	(0.50)
Years of education	13.11	11.83
	(2.81)	(2.89)
Initial earnings	27,266.79	15,071.00
	(41,111.12)	(17,041.36)
Potential DI benefit	872.67	763.62
	(291.61)	(275.68)
Disability accepted	–	0.65
	–	(0.48)
Age	57.03	56.44
	(3.73)	(3.80)
Prior work-limiting condition	0.11	0.93
	(0.31)	(0.25)

Notes: Averages and standard deviations are in parentheses of selected characteristics by DI applicant population in comparison to non-applicant population. Unit of analysis is person-year, limited to all individuals who have not previously applied to DI.

TABLE B2—IMPACT OF DEMOGRAPHIC CHARACTERISTICS ON HAVING BEEN SENT A SOCIAL SECURITY STATEMENT

	Ever received statement
Less than high school	0.006
	(0.007)
High school	0.005
	(0.005)
GED	0.003
	(0.008)
Some college	0.011
	(0.008)
Full college	0.006
	(0.009)
Postgraduate	0.016
	(0.011)
Female	0.013
	(0.027)
Work-limiting condition	−0.004
	(0.004)
Initial earnings	2.17e-08
	(3.61e-08)
PIA	0.004
	(0.003)
Age fixed effects	Yes
Year fixed effects	Yes
Constant	−0.128
	(0.017)
Observations	41,669
R^2	0.781

Source: Health and Retirement Study sample, Waves 1–7

TABLE B3—KEY VARIABLE COMPARISONS BETWEEN UNMATCHED AND MATCHED HRS SAMPLES

	Full sample, matched to SSA records ($N = 41{,}669$)		Not matched to SSA records ($N = 6{,}782$)		
	Mean	SD	Mean	SD	p-value
Male	47.3%	49.9%	48.2%	50.0%	0.19
Years of education	13.08	2.82	13.05	2.98	0.55
Initial earnings	26,995.69	40,770.47	27,158.42	31,069.71	0.05
Applied for disability	2.8%	16.5%	3.0%	13.9%	0.36
Accepted into disability	1.9%	13.5%	2.2%	10.9%	0.30
Age	57.02	3.74	57.29	3.69	0.11
Any work-limiting condition	12.9%	26.5%	13.3%	34.0%	0.34

Source: Health and Retirement Study sample, Waves 1–7

Table B4—Effect of Statement Receipt on DI Application by Prior Work-Status and Educational Attainment, by Previous Work-Limitation, Linear Probability Coefficients

	Full		Work-limited	
	(1)	(2)	(3)	(4)
Working (lagged)	−0.026		−0.025	
	(0.005)		(0.016)	
Statement	0.007		0.090	
	(0.007)		(0.041)	
Statement × working (lagged)	0.001		0.004	
	(0.005)		(0.026)	
High school or less				
Any college		−0.021		−0.050
		(0.007)		(0.019)
More than college		−0.015		−0.054
		(0.003)		(0.023)
High school or less × statement		0.020		0.191
		(0.020)		(0.052)
Any college × statement		−0.019		−0.090
		(0.009)		(0.032)
More than college × statement		−0.001		0.001
		(0.005)		(0.031)
Cohort-specific linear time trends	Yes	Yes	Yes	Yes
DI covered only	Yes	Yes	Yes	Yes
Person-years	27,406	41,669	2,537	4,882
R^2	0.013	0.014	0.135	0.128

Notes: Linear probability regression (weighted) using individuals 51–64 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 HRS interview. "Working (lagged)" is an indicator for whether the respondent had any hours worked greater than zero in the prior interview. All regressions control for gender, educational attainment, race/ethnicity, marital status, and reduction in OAI benefits due to rising full retirement age. Sample limited to living, DI covered individuals, age 51 to 64. Robust standard errors are in parentheses, two-way clustered at the year and birth-year levels.

TABLE B5—EFFECT OF STATEMENT RECEIPT ON DI APPLICATION BY PRIOR HEALTH CONDITION, BY PREVIOUS WORK-LIMITATION, LINEAR PROBABILITY COEFFICIENTS

	Full sample		Work-limited	
	Binary (1)	Continuous (2)	Binary (3)	Continuous (4)
Back problems	0.002	0.004	0.023	0.041
	(0.003)	(0.009)	(0.015)	(0.052)
CESD	0.044	−0.020	0.138	0.025
	(0.013)	(0.044)	(0.032)	(0.009)
ADL	0.041	0.018	0.123	0.018
	(0.005)	(0.025)	(0.040)	(0.054)
IADL	0.002	0.004	0.089	0.164
	(0.005)	(0.008)	(0.041)	(0.073)
Work-limiting	0.081	0.081	–	–
	(0.015)	(0.040)	–	–
Statement receipt	−0.007	−0.006	0.124	0.103
	(0.009)	(0.010)	(0.037)	(0.045)
Back × statement	−0.005	−0.003	−0.056	0.001
	(0.004)	(0.006)	(0.036)	(0.040)
CESD × statement	−0.002	0.006	−0.006	0.007
	(0.023)	(0.005)	(0.059)	(0.012)
ADL × statement	0.073	0.017	0.059	0.061
	(0.014)	(0.004)	(0.069)	(0.064)
IADL × statement	0.086	0.027	0.070	−0.017
	(0.018)	(0.016)	(0.060)	(0.087)
Work-limiting × statement	0.087	0.054	–	–
	(0.033)	(0.018)	–	–
Cohort-specific linear time trends	Yes	Yes	Yes	Yes
Person-years	41,669	41,669	4,882	4,882
R^2	0.193	0.158	0.193	0.190

Notes: Linear probability regression and logit (weighted) using individuals 51–64 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 HRS interview. Back is whether an individual reported a back problem in the prior period. CESD is whether an individual reported issues in at least four items in the eight-point Center for Epidemiological Studies Depression scale in the HRS. IADL is reporting at least one limitation to an (instrumental) activity of daily living. Continuous measures are then calculated as the number of these issues instead of a binary indicator. All regressions control for gender, educational attainment, race/ethnicity, marital status, and reduction in OAI benefits due to rising full retirement age. Sample limited to living, DI covered individuals, age 51 to 64. Robust standard errors are in brackets, two-way clustered at the year and birth-year levels.

Table B6—Effect of Statement Receipt on DI Application by Potential DI Benefit (PIA) Quintile, Full and Previously Work-Limited Samples, Linear Probability Coefficients

		DI application			
		Full		Work-limited	
		(1)	(2)	(3)	(4)
PIA quintile					
	Bottom	0.037	0.037	0.057	−0.024
		(0.018)	(0.017)	(0.055)	(0.026)
	Second	0.021	0.021	0.035	0.010
		(0.007)	(0.006)	(0.037)	(0.023)
	Middle	0.017	0.017	0.064	0.020
		(0.006)	(0.006)	(0.032)	(0.026)
	Fourth	0.013	0.012	0.041	0.031
		(0.007)	(0.007)	(0.037)	(0.024)
	Top	–	–	–	–
		–	–	–	–
PIA quintile × statement receipt					
	Bottom	0.027	0.024	0.165	0.189
		(0.023)	(0.023)	(0.114)	(0.075)
	Second	0.019	0.012	0.170	0.169
		(0.010)	(0.017)	(0.084)	(0.086)
	Middle	0.019	0.004	0.140	0.090
		(0.012)	(0.016)	(0.064)	(0.067)
	Fourth	0.006	0.002	0.044	0.068
		(0.010)	(0.016)	(0.066)	(0.068)
	Top	−0.009	−0.014	−0.036	−0.016
		(0.008)	(0.015)	(0.083)	(0.072)
Separate age and year dummies		Yes	No	Yes	No
Cohort-specific linear time trends		No	Yes	No	Yes
DI covered only		Yes	Yes	Yes	Yes
Person-years		41,669	41,669	4,882	4,882
R^2		0.028	0.024	0.188	0.164

Notes: Linear probability regression (weighted) using individuals 51–64 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 been sent a Social Security statement (except if applied for DI before statement receipt). Work-limiting condition is self-reported work-limitation in the previous HRS interview. PIA quintile is which fifth of the potential monthly DI benefit distribution the individual is in at first HRS interview. All regressions control for gender, educational attainment, race/ethnicity, marital status, and reduction in OAI benefits due to rising full retirement age. Sample limited to living, DI covered individuals, age 51 to 64. Robust standard errors are in brackets, two-way clustered at the year and birth-year levels.

TABLE B7—EFFECT OF STATEMENT RECEIPT ON DI APPLICATION BY CENSUS DIVISION OF RESIDENCE, FULL AND PREVIOUSLY WORK-LIMITED SAMPLES, LINEAR PROBABILITY COEFFICIENTS

	DI application			
Linear probability model	Full sample		Work-limited	
Census division × statement	(1)	(2)	(3)	(4)
New England	0.011	−0.001	0.059	0.007
	(0.017)	(0.022)	(0.075)	(0.086)
Middle Atlantic	0.026	0.014	0.132	0.092
	(0.013)	(0.019)	(0.053)	(0.078)
EN Central	0.023	0.011	0.130	0.090
	(0.018)	(0.024)	(0.064)	(0.094)
WN Central	0.014	0.002	0.071	0.022
	(0.018)	(0.020)	(0.059)	(0.061)
S Atlantic	0.013	0.001	0.091	0.051
	(0.014)	(0.020)	(0.053)	(0.087)
ES Central	0.035	0.023	0.192	0.166
	(0.019)	(0.022)	(0.062)	(0.084)
WS Central	0.040	0.028	0.152	0.116
	(0.016)	(0.023)	(0.044)	(0.080)
Mountain	0.015	0.003	0.079	0.037
	(0.012)	(0.016)	(0.055)	(0.055)
Pacific	0.014	0.002	0.122	0.085
	(0.013)	(0.017)	(0.069)	(0.064)
Separate age and year dummies	Yes	No	Yes	No
Cohort-specific linear time trends	No	Yes	No	Yes
DI covered only	Yes	Yes	Yes	Yes
Person-years	41,669	41,669	4,882	4,882
R^2	0.029	0.025	0.164	0.142

Notes: Linear probability regression (weighted) using individuals 51–64 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 been sent a Social Security statement (except if applied for DI before statement sending date). Work-limiting condition is self-reported work-limitation in the previous HRS interview. All regressions control for gender, educational attainment, race/ethnicity, marital status, and reduction in OAI benefits due to rising full retirement age. Sample limited to living, DI covered individuals, age 51 to 64. Robust standard errors are in brackets, two-way clustered at the year and birth-year levels.

Table B8—Effect of Statement Receipt on DI Application, by Clustering Level, Full and Previously Work-Limited Samples, Linear Probability Coefficients

	Full sample				Previously work-limited			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Statement	0.010	0.010	0.010	0.010	0.092	0.092	0.092	0.092
	(0.008)	(0.006)	(0.007)	(0.004)	(0.043)	(0.029)	(0.040)	(0.024)
Cluster level	Birth-year, year	Birth-year	Year	Respondent	Birth-year, year	Birth-year	Year	Respondent
Person-years	41,669	41,669	41,669	41,669	4,882	4,882	4,882	4,882
R^2	0.025	0.025	0.025	0.025	0.154	0.154	0.154	0.154

Notes: Linear probability regression (weighted) using individuals 51–64 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 HRS interview. All regressions control for gender, educational attainment, race/ethnicity, marital status, reduction in OAI benefits due to rising full retirement age, and cohort-specific linear time trends. Sample limited to living, DI covered individuals, age 51 to 64. Robust standard errors are in parentheses, clustered at the indicated level.

Data Appendix

The dataset I use in this analysis—the health and retirement study (HRS)—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 seven cohorts:

(i) The Initial HRS cohort, born between 1931 and 1941, first interviewed in 1992 and reinterviewed every two years;

(ii) 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;

(iii) Children of Depression (CODA) cohort, born 1924 to 1930, first interviewed in 1998 and subsequently every two years;

(iv) War Baby (WB) cohort, born 1942 to 1947, first interviewed in 1998 and subsequently every two years;

(v) Early Baby Boomer (EBB) cohort, born 1948 to 1953, first interviewed in 2004;

(vi) Mid Baby Boomer (MBB) cohort, born 1954–1959, first interviewed in 2010;

(vii) Late Baby Boomer (LBB) cohort, born 1960–1965, first interviewed in 2016.

For this analysis, I primarily draw from the initial cohort, as well as the CODA and WB cohorts, since the later cohorts enter after the statement has been universally provided, and the last year I use in any of my samples is 2004. These panels are then matched to Social Security Respondent Cross-Year Summary Earnings, for which the match rate is approximately 72 percent among the cohorts I use, and 75 percent overall for the initial cohort (Mitchell, Olson, and Steinmeier 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 of the full HRS (Kapteyn et al. 2006, Michaud and Van Soest 2008).[25] 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 observe only self-reported earnings. Additionally, individuals who had their SSA records matched previously were still in the panel in 2004, and provided consent, had their earnings and benefits records updated with information from the intervening years.

I use self-reported DI application dates[26] from the RAND HRS Version P file, since for over half of my sample, administrative data has not been rematched.[27] For those for whom there is a match, the correlation between self-reported and administrative DI applications is greater than 0.8. Therefore, these records provide historical earnings but are not updated for every individual. These historical earnings and quarters of coverage (QC), when combined with statutory rules on the number of calculation years and QCs required by age, allow me to assign DI coverage status and potential DI monthly benefit displayed on the statement (referred to in this paper as the DI PIA) in either 1994—before anyone received a statement—or in the last year of their match, whichever was earlier.[28] 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 benefit, since these values change

[25] Appendix Table B3 shows that for a set of key variables in this study, there is no statistically significant difference between the matched and unmatched sample, with one exception: initial earnings. Given the overall results of my analysis—that those with previous work-limiting health conditions are the most responsive to the statement—these results may be underestimates of the true effect if those outside of the labor force due to health conditions are underrepresented in the matched HRS-SSA population.

[26] Although before wave 5 of the HRS (year 2000), there is not separate identification of application for SSI, the other federal civilian 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).

[27] Additionally, Appendix Figures A1 and A2 draw on a further match with matched Form 831 DI application data, containing information on month and year of DI filing, but the subsample of individuals for whom a successful Form 831 match is available is skewed due to the necessity of a 2004 rematch, which excludes those who exit the HRS by or before 2004 or who do not provide subsequent match permission.

[28] 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 alternate procedures to calculate pre-statement coverage status and these alternative analyses are available upon request.

depending on individual labor supply, which the statement can influence. DI coverage status and potential benefit are thus constant for all within-person years.[29]

Where possible, I use the RAND HRS Version P file, a cleaned and standardized version of the public-use HRS available publicly on the HRS website, for any HRS core module question available therein. Notably, 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.[30] As discussed in the data section in the main body of the paper, my analytic sample uses the person-interview-year as the unit of analysis. For each individual, there is a separate observation for every interview date they were "at risk" of applying for DI from 1992–2004.

The policy intervention under study is the Social Security statement, which I measure as whether an individual was sent a Social Security statement at any point before the current HRS interview. For my primary analysis, statement receipt is an absorbing state, whereby once an individual has been sent a statement, this variable is one until they leave the sample.[31] Since I observe month and year of birth, interview month and year, and DI application month and year, I determine if an individual was sent a statement prior to an interview. However, if an individual both applies for DI and was sent a statement since his last interview, but he applied for DI first, the statement receipt variable is set to zero.

Throughout the analysis described below, I include additional variables, both as controls and as interactions or subgroups to estimate a separate statement effect. Most notably, these measures include prior and current health status, prior work status, geographic location, potential DI benefits, and prior Social Security knowledge.

The HRS asks individuals a range of questions relating to disabilities. Of particular note is the construction of the work-limitation variables: the HRS asks all respondents whether they have a health condition that limits the type or extent of work they can do. Unless noted otherwise, I define an individual as being work-limited if they answered yes to this question in the prior wave. Although much of the analysis will define "work-limited" as reporting a health condition that limits or prevents work in the previous wave, additional analyses defining "work-limited" as reporting such a condition in the respondent's first HRS survey are included, i.e., "baseline WL." All of the results presented in this analysis that instead use this baseline work-limited definition find very similar results, both qualitatively and quantitatively.

In addition to the general measure of a work-limiting health condition, in every wave, individuals are asked extensive questions on conditions that may affect

[29] Sample construction is discussed in detail below, but it is worth noting here that insomuch as individuals may lose their DI coverage status due to exit from the labor force during my sample window, my results based on these ineligible individuals would therefore be biased toward zero.

[30] Although application dates are available through the Form 831 SSA 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.

[31] Although it would be possible to estimate a within-cohort equation, exploiting variation across birth month versus interview month, such a strategy severely reduces the power of the analysis, measures only the immediate effect of statement receipt, and would require large administrative data samples. Given that heterogeneity in response across preexisting personal characteristics is a central finding of this paper, and administrative data could not identify the mechanisms I do explore, I forgo such an approach of greater sample sizes for a richer dataset.

activities of daily living or instrumental activities of daily living, a Center for Epidemiologic Studies Depression (CESD) battery of questions, and whether they have pain-related back problems. The HRS includes core questions on labor force status; I construct a lagged indicator of whether an individual was working during the last interview with any positive number of hours worked during "a usual week." To estimate geographic heterogeneity in the statement's effect, I use the publicly available census division of current residence.[32]

Additionally, I construct a measure of the potential DI benefit if accepted into the program 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. Note that this benefit is the monthly DI PIA that an individual would receive if they were deemed eligible for the program at the time of statement calculation.

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[32] Although there are much finer measures of area of residence in restricted-use HRS files, these measures are not available for researchers using the HRS matched to SSA records.

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