Social Security Disability Applications near Retirement Ages†

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September 22, 2014

Abstract

How much do more generous Social Security Disability Insurance (DI) benefits encourage disability applications? This relatively straightforward question has proven difficult to answer empirically due to the challenges present in distinguishing between the effects of cash benefits and those of health insurance provided to DI beneficiaries through the Medicare program. As a result, existing estimates of cash benefit elasticities may be biased. In order to identify the effect of cash benefits on the application decision, variation in cash incentives independent of Medicare health insurance benefits is needed. We propose a new approach to estimating the benefit elasticity of disability applications that capitalizes on just such variation, while purging the cash incentive effect of the medical coverage incentive effect. We focus on the special age window between the Early Retirement Age (ERA) and the Normal Retirement Age (NRA), and exploit an exogenous variation in disability cash benefits that results from the fact that for Americans born after 1937 disability benefits are increasingly more attractive compared to Old Age benefits due to the increase in the NRA, which increased the penalty for early retirement. This quasi-experimental approach allows us to more reliably estimate the effect of cash benefits on the decision to file for disability benefits.

JEL Classification: H5
Keywords: Disability and Disability Insurance; Retirement; Social Security

† Benítez-Silva acknowledges the financial support from the Spanish Ministry of Science and Technology through project numbers SEJ2005-08783-C04-01, ECO2011-30323-C03-02, ECO2008-06395-C05-01 and ECO2010-21706. Na Yin thanks the Center for Retirement Research at Boston College and the Professional Staff Congress at City University of New York (research award number 63887-00-41) for their financial support.
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1. Introduction

The Social Security Disability Insurance (DI) program is the primary cash transfer program for disabled workers and their dependents in the United States. It provides partial earnings replacement to workers who lose earnings capacity due to severe and long-term disabilities, and health insurance through the Medicare system after a two-year waiting period. As of February of 2014, DI provided benefits to about 8.93 million workers who receive on average more than $1,145 per month. The program received nearly 3 million applications per year between 2009 and 2012, and awarded benefits to about one million individuals in each of those years.[1] The number of applicants to the DI program has doubled since 2000. There is considerable interest among researchers and policy makers in understanding this phenomenon, which is likely explained by a combination of demographic, social, and labor market trends, and the changes in the retirement benefit structure that started at the beginning of this century.[2]

The growth of the DI program is in part related to its financial generosity. The program offers a level of benefits, at the time of eligibility, which is approximately equal to the full Social Security retirement benefit, the benefit level received at the Normal Retirement Age, specific to a recipient's earnings history. Given the sheer size and importance of the DI program it is natural to ask: how responsive are applications to the program changes in benefits? A large literature (discussed in Section 4), has attempted to estimate the benefit elasticity of DI applications. The benefit elasticity is a key policy parameter. It determines the effects of the policy reforms that change the cash benefit incentives of the DI program, as well as changes to other programs that change the comparative generosity of the DI system.[3] Chief among the latter is the Social Security OA system, which changed during the last decade, will continue to change in the second part of this decade, and will likely change further in the years to come, given the fiscal projections of the SSA. Interestingly (and rather ironically) the policy changes that make the study of the elasticity of DI benefits an increasingly important research question also allow us to

[1] The program also provides benefits to around 1.89 million children and 153,000 spouses. The number of applicants mentioned in the text refers to workers only. The total number of claimants is more than 3.6 million per year. Concern with growth of this program dates back at least to the early 1990s, as discussed in GAO (1993, 1994, and 1995). At that time, policy makers were very concerned with the sharp growth in applicants, even though it was only a fraction of the tremendous growth we have seen in recent years. During 2013 the number of applications declined by 6.4 percent and the number of awards by 9.7 percent, but still more than 2.6 million Americans applied for DI and nearly 900,000 were awarded benefits last year.

[2] The other major disability program in the United States is the Supplemental Security Insurance program (SSI), which provides disability benefits to the disabled poor. It is means-tested, and eligibility is not linked to past labor force activity. The SSI provides benefits to around five million individuals, aged 18 to 64, as of February of 2014, who received on average about $552 dollars per month. In February 2014, more than 1.61 million individuals received SSI and DI at the same time.

[3] While these policies are usually only considered for those already on the rolls, it stands to reason that they might have an induced entry effect, affecting the likelihood of application to the program by those considering whether that is the best option to them, considering their labor force attachment.

better estimate this elasticity, once coupled with widely ignored (for the purpose of estimating the elasticity of applications with respect to cash benefits) institutional features of the DI system regarding Medicare eligibility for individuals who apply for DI in their early 60s.

The key underlying question of our research effort is: How sensitive are disability applications to the generosity of benefits? Answering this question has proven difficult due to researchers' limited ability to distinguish empirically between the effects of cash benefits and those of health insurance provided to DI beneficiaries through the Medicare program. As a result, existing estimates of cash benefit elasticities may be biased. In order to identify an effect of cash benefits on the application decision, variation in cash incentives independent of Medicare health insurance benefits is needed. We propose a new approach to estimating the benefit elasticity of disability applications that capitalizes on just such variation, while purging the cash incentives effect of the effect of medical coverage incentives. We focus on the special age window between the Early Retirement Age (ERA) and the Normal Retirement Age (NRA), and exploit an exogenous change in disability cash benefits that results from the fact that, for Americans born after 1937, disability benefits have become increasingly attractive compared to OA benefits due to the increase in the NRA that increased the penalty for early retirement. This quasi-experimental approach allows us to more reliably estimate the effect of cash benefits on the decision to file for disability benefits.[4]

The number of DI applicants at age 62 and over has grown tremendously and at a much faster rate than the number of younger applicants in the last decade (See Figure 1). For example, the growth rate in DI applications at age 62 and over was 75percent between 2000 and 2005, 100percent between 2000 and 2007, and 167percent between 2000 and 2010. The 62-64 age group is the one that shows the largest increase in applications in the last decade.[5] The dramatic growth in DI applications at older ages probably has to do with baby boomers aging and the overall attitudes towards the role of SSDI when serious health problems appear late in life, which also coincides with a period when the increased penalty on early retirement benefits claiming, due to increased NRA, started to take effect and this change in OA benefits makes DI benefits comparatively more appealing to eligible individuals.

[4]According to the Social Security Administration (SSA) Annual Statistical Report on the SSDI program (2012), 154,525 workers aged 62-64 applied for DI benefits in 2012, and 46 percent of them were awarded the benefits (with some 6,671 cases still pending decisions). If we include those who applied at age 65 (before they reach their NRA of 66) the number of applicants goes up by 23,838, and the award rate for this group is 30 percent.

[5] Except the group under age 30 who experienced even faster growth in DI applications in the comparable periods. A detailed analysis of the role of age in the DI applications and awards of individuals is provided in Benítez-Silva and Yin (2014).

Our quantitative findings indicate that, adjusting for the possible selectivity in the timing of DI applications and for the endogeneity of OA claiming decisions, the overall elasticity of the application probability with respect to increases in benefits ranges from 0.86 to 1.02. Since the recent increase in the NRA from 65 to 66 made the DI program 25 percent more attractive (at the ERA) relative to OA, our elasticity estimates suggest this resulted in a 22 to 26 percent increase in applications to DI among older individuals, which, in turn, accounts for at most 26 percent of the 100-percent-increase in applications at older ages (age 62 to 64 for appropriate comparability between periods) from 2000 to 2007 and about 16 percent of the 167-percent-increase in the 2000 to 2010 period.[6]

Our elasticity estimates suggest that, as the NRA increases to age 67, the comparative generosity of the DI program will increase substantially. All else the same, we can expect applications to the DI program to continue to increase by up to 20 percent at these ages, through this channel. The reason for this is that the NRA will start to increase again in 2017 for cohorts born after 1954, increasing by 2 months per birth year for younger cohort, until it reaches age 67 for all those born in 1960 or later. For the latter cohorts, the differences in benefits between disability and retirement at age 62 will be 30 percentage points of the PIA (70 percent versus 100 percent), an increase of 42.9 percent in lifetime benefits, and an increase of 50 percent in the comparative appeal of disability (increase of 10 percentage points from 20 percent lifetime gain to 30 percent lifetime gain) with respect to OA, if compared with the cohorts for whom the NRA was 65. Given this increasing appeal of DI, the spillover effect could be significant from OA to DI program, therefore the actual savings from the scheduled OA program reforms will be partly offset by increases in DI benefit outlays and administrative costs.[7]

The organization of the paper is as follows: In Section 2 we discuss several distinctive features characterizing the Social Security incentive structures for individuals of age 62 and over. In Section 3 we further discuss the incentives to apply for DI benefits at different ages. The main empirical challenges in estimating the benefit

[6] We compute the increase in applications for individuals 62 to 64 by using the aggregate information reported in the Annual Statistical Report on the SSDI Program (2012), which are compendiums of all relevant statistics of the SSDI program, but augmented with information sent to us by the Social Security Administration directly at our request about the age breakdown of applicants by age, which is not provided in the Statistical Report or the Statistical Supplement to the Social Security Bulletin (2013). The new information provided to us by the SSA is a more detailed and correct version of Table 59 of the Annual Statistical Report on the SSDI program, and shows the reported 100 percent increase in applications of individuals 62 to 64 in the 2000 to 2007 period, and 167 percent increase in the 2000 to 2010 period. For the purposes of assessing the quantitative nature of our results, we choose to focus on the 2000 to 2007 period, mainly because the subsequent period up to 2010 is heavily influenced by the Great Recession, and it is a period in which there were no increases in the NRA, while the earlier period was precisely when the increases of the NRA happened.

[7] A rising number of DI applications could also increase SSA's workload, and its administrative expenses. The latter have doubled, to around 3 billion dollars, from 1999 to 2012. Additionally, the increase in the number of applications will likely increase the number of pending claims at all levels of the disability determination process.

elasticity of DI applications are discussed in detail in Section 4. The empirical estimation and identification strategies are presented in Section 5. The data used in this study, the construction of the sample, the key variables used in the estimation, as well as the econometric specifications are discussed in Section 6. Results are presented in Section 7, and Section 8 concludes and provides additional discussion.

2. Distinctive Features in the Social Security Incentive Structures for Individuals of Age 62 and Over

Three distinctive features characterize the Social Security incentive structures for individuals past age 62, the Early Retirement Age. First, they can claim OA benefits. Policy changes such as increasing the NRA reduce the generosity of OA benefits, and are expected to increase the relative attractiveness of DI benefits. Individuals near the Social Security retirement ages in recent years have experienced such an exogenous benefit variation providing an opportunity to analyze the cash benefit effects on DI applications.

Second, after age 62 any effects of Medicare on DI applications are minimal, so at that age it becomes possible to estimate a cleaner effect of cash benefits on DI applications. DI applications by individuals with ages between the ERA and NRA are unlikely to be motivated by the Medicare coverage provided by DI because, Medicare coverage becomes available to DI awardees only 24 months following a DI benefit entitlement and so would become available at age 65 regardless his DI application. Taking into account the lengthy determination process of about a year (in the data, the average waiting time until an award decision is made is about a year, which includes the statutory five-month waiting period from the onset of disability until the award, administrative lags, and time for appeals.), an applicant in the ERA-NRA window would almost surely reach age 65 and gain Medicare coverage regardless of the outcome of the DI application.[8] Thus focusing on this age window would provide for a relatively clean estimate of cash benefit effects purged of Medicare effects on DI applications.

[8] For an analysis of the delays in the DI determination see Benítez-Silva et al. (1999). Moreover, SSA continues to face disability claim backlogs. According to GAO (2010), SSA has experienced processing delays and an increase in the total number of claims pending at the initial level of the disability determination process. In the fiscal year (FY) of 2009, the average processing time for claims at the initial stage was 101 days –an improvement over FY 2008 (106 days), but a decrease from FY 2006 (89 days). At the end of FY 2009, there were about 780,000 initial claims pending, a 40 percent increase from FY 2007. Although SSA has made progress in reducing its backlog at the hearings level, as of 2008 the average processing time for claims at this level was 514 days. Strictly speaking the Medicare entitlement can be established retroactively as discussed in Bye and Riley (1989). In their study of 1987 recipients (we are not aware of any study using more recent data on this issue) they found that in a large percentage of cases this is what happened (as much as 40 percent). This means that even if we restrict attention to this age cohort there could be a residual health care incentive, suggesting that our findings could still include a possible upward bias because of this.

The incentive structure in the DI program is more complex for people younger than 62, whose decision to apply for DI is driven by either the cash benefits mainly or Medicare mostly or both equally. The empirical challenge in properly measuring the Medicare effect, and the potential correlation between Medicare preferences and DI benefits in affecting DI applications, raises some concern about the reliability of cash benefit effects estimated for younger ages. (We will discuss these aspects in detail in Section 4) It is therefore advantageous to focus on the age window between ERA and NRA when the Medicare value through DI almost has no effect on the DI application decisions.

Thirdly, the Social Security quarters of coverage (QCs) requirements are the same (40 QCs) for disability and retirement programs for individuals at the age of 62 or above, while this requirement is more relaxed and depends on age for disabled individuals who are younger. The various eligibility requirements across age for younger disabled workers make it hard to distinguish the effect on DI applications of benefit amounts from the effect of more generous work credit eligibilities. Individuals older than age 62 who are eligible for retirement benefits and disability benefits are a more homogeneous group in terms of work credit requirements. It would rule out a source of variations in DI applications from work history eligibilities.

3. Age and the Incentives to Apply for DI Benefits

Interestingly, the incentives to apply for DI benefits at different ages, in spite of its importance, are not a topic discussed in detail in the DI literature. The calculation of DI benefits is in principle similar to the calculation of retirement benefits, but instead of taking into account the 35 highest years of earnings out of the last 40, the formula only takes into account the years between the time the person turned 21 and the year at which the person becomes eligible for DI benefits. This makes the DI system more generous at younger ages by design. As we will see below with an example, the generosity is quite striking, but it is in line with the idea that DI is an insurance program, which compensates individuals who have had the bad fortune of becoming disabled, even if they had contributed relatively little to the system before the onset of their disability.

The generosity of the system has two components. The first one as we have described has to do with the comparative generosity of DI with respect to OA benefits at a time that both are available. For example, think of two 62 years old individuals, one receiving DI, and one receiving Old Age benefits, who are entitled to very

different levels of benefits, with the DI recipient receiving 100percent of his PIA, while the OA recipient (assuming an NRA of 66) receiving only 75percent of his PIA. Those two individuals, however, assuming essentially identical earnings histories up to age 62, would have paid the same amount of Social Security taxes to the system. However, that is not true for individuals before age 61, and that sets the stage for the second component of the generosity of the system, which could be considered the pure insurance component. That second component, has to do with the very different level of taxes paid by recipients of ages younger than 61, and exemplifies the pure insurance nature of the DI program. This latter point can be characterized with an example.

Think of someone who, for example, is awarded DI benefits at age 41, after starting to work at age 29, and working continuously thereafter. This person will get to compute his PIA based on 20 years of earnings, with the possibility of dropping as many as 1/5 of the years of earnings (with a maximum of 5 dropout years). In this case, the person has 8 zeros in their history of earnings, but can drop four of them, so the calculation of the PIA takes into account only 16 years of earnings, and this person has 12 of them with positive earnings. The person will get a benefit equivalent to that of a non-disabled individual who reaches the NRA (say 66) with a history of earnings with ¾ of the years with positive earnings (12/16). That means the disabled individual with these characteristics will get the same benefits as someone who worked during a bit more than 26 years and claimed benefits at the NRA of 66.

Given similar histories of (adjusted) earnings these two individuals, the DI recipient with 12 years of work and the retiree with 26 years of work will receive exactly the same benefits. Notice that the DI recipient receives the same amount a retiree at the NRA but after paying a much lower amount in taxes to the system (less than 50 percent of the taxes), but of course the key is whether the DI recipient receives benefits long enough to end up receiving a higher lifetime benefit with respect to taxes paid than the OA retiree. To gather information on expected lifetime on the DI and OA rolls we have looked at data collected by the SSA in a variety of reports. The information using Zayatz (2011) and also the Life Tables provided online by the Office of the Chief Actuary indicate that the average expected years on the DI rolls for a 41 year old (male), and the average years on the OA system for a 66 year old are surprising similar, around 16, suggesting that the generosity of the DI system is quite significant for individuals who enter the rolls at ages well before they have contributed substantially to the Social Security system.

What this example shows is that in relation to the contributions to the system, DI is very generous compared with retirement for young workers, which could be understood as its purely insurance component. However, this comparative generosity declines with age, and at age 61 no longer exist (since then, 35 of years of earnings are considered), and the only remaining generosity is the one compared with the retirement benefits starting at age 62, but then the very existence of retirement benefits changes the incentives considerably.

On top of these two components of generosity, DI benefits pay considerably higher benefits to individuals with dependents, as much as 180percent of the individual benefits when children are present, resulting in an even higher comparative generosity, especially striking for younger individuals, with younger families.

4. Empirical Challenges in Estimating Cash Benefit Elasticities of DI Applications

To identify the effects of the cash benefits on DI applications, we need to exploit some exogenous variation in cash benefits that is independent of the Medicare effects in DI. Much of literature has focused on how to find exogenous variation in cash benefits. The potential correlation between the financial incentives and Medicare incentives in DI and the possible bias in benefit elasticity estimates resulting from that correlation has rarely been discussed. In this section, we will discuss in detail these empirical challenges.

4.1 Research efforts searching for an appropriate measure of the DI financial incentives

Trying to identify the effect of benefit changes on disability applications is no small task given the uncontroversial endogeneity of the observed benefit levels in a given sample, since they are just a function of earnings histories which are a function of previous choices as well as unobserved components correlated with preferences for work and for health insurance. Not even the non-linear relationship between earnings histories and benefits (i.e. the replacement rate) provides much hope in the search for identification without relying on exogenous sources of variation in benefits.

Enormous effort, therefore, has been devoted to the search for an appropriate source of exogenous variation in DI financial benefits in the DI application models.[9] For example, Gruber (2000) takes advantage of the two different disability pension plans in Canada (Quebec vs. the rest of Canada), uses a 36-percent increase in DI

[9] Bound and Burkhauser (1999) provide an excellent discussion of previous studies on the behavioral effects of disability programs.

benefits in one plan but not the other, and estimates an elasticity of labor non-participation of 0.28-0.36 induced by DI benefits. Black et al. (2002) use data from the coal boom of the 1970s and the coal bust of the 1980s to study the impact of local labor market conditions on disability program participation. They estimate that the elasticity of DI program payments with respect to local earnings is between -0.3 and -0.4. A handful of recent papers (Duggan, Singleton and Song, 2007; Li and Maestas, 2008; and Coe and Haverstick, 2010) views increases in the NRA resulting from the reforms on the OA program as exogenous increases in the generosity of the DI benefits relative to OA benefits for younger as compared to older cohorts. The source of variation in (comparative) DI benefits is solely the different years of birth, which is exogenous (though possibly confounded by other changes across cohorts) in DI models. Duggan, Singleton and Song (2007) find that raising the NRA led to an increase in DI enrollment of 0.6 percent for men and 0.9 percent for women aged 45 to 64 in 2005. Li and Maestas (2008) conclude that a 4-month increase in the FRA increases the 2-year DI application rate by 0.04-0.30 percentage points on average and by 0.22-0.89 percentage points among those with a work-limiting health problem. Additionally, Maestas et al. (2012) exploit changes over time and across states in real relative SGA levels, relative to local average wages and find that a 7 percentage point (30percent) increase in the real relative SGA was associated with a 4.7percent increase in DI applications. One concern is that these studies pool together the ages that are both close to and farther from the NRA, and do not recognize that individuals younger than age 62 and those beyond age 62 face different incentive structures as we discussed earlier, making their results hard to interpret.

In this paper, we apply this cohort approach but focus on an age window near the NRA. Some features of this age window as we discussed earlier make the cohort approach more suitable for estimating a cash benefit effect on DI applications: First, the effect of Medicare value on DI applications is minimal, which leaves cash benefits as the main driver of applicants; Second, the comparison between Social Security disability benefits and retirement benefits is more appropriate for individuals near Social Security retirement ages when both benefit options are available; Third, DI eligibility requires the same quarters of coverage for these ages (but not for younger ages); Fourth, we observe a fastest growth in DI application among this age group in the last decade when increases in the NRA resulting from the reforms on the OA program changes the relative generosity of the DI benefits (Figure 1).

The cohort studies mentioned earlier pooled younger and older ages together and implicitly assumed that 40s and 50 year olds are extremely forward-looking and make DI application decisions by comparing current disability

benefits with prospective retirement benefit payments that do not begin for another 10 to 20 years. Even if people are that forward-looking, the correct comparison governing a younger individual's DI decision should be between receiving lifetime DI benefits starting in his 40s or 50s versus working until age 62 (or older) and then receiving retirement benefits from the retirement age onwards. In that case, an individuals' expected work earning trajectories over the future decades should have (but mostly have not) been accounted for in the DI application model. We separate the sample by age and concentrate on individuals 62 and older (but younger than NRA) because they actually have access to both retirement benefits and disability benefits. For these individuals the comparative attractiveness of disability is more meaningful than for younger individuals, who are years away from having access to retirement benefits. Many researchers in the last decades have purposely avoided these older individuals because of the potential problem of having to account for the additional benefit structure coming from the Old Age benefits program (e.g. Haveman, De Jong and Wolfe, 1991; Kreider and Riphahn, 2000). Others, like those mentioned above, have pooled the data by age. The latter is a key issue because it can potentially confound a pure cohort effect with a truly meaningful effect of facing a more appealing disability benefit structure.

This increased appeal of DI benefits with respect to retirement benefits was also discussed in GAO (1999) and revisited in GAO (2010). However, due to the nature of the data they use, the two reports only analyze the effect of the relative increase in benefits on the award probability, which is a combination of the application decision of individuals and the award decision taken by the government.

A key contribution of our work is that using individuals age 62 to the NRA provides for a cleaner estimation of the cash benefit effect of disability benefits, since for this sample the Medicare incentives are likely to be minor, given that individuals would receive Medicare anyway when they reach age 65. This is an important matter because again previous research has estimated a potentially confusing measure of the effects of benefit increases on the disability program because it included individuals for whom Medicare is likely to be quite an important matter.

4.2 Medicare effect in the DI program is an important confounder but hard to measure empirically

An important in-kind benefit provided by the DI program is Medicare coverage two years after cash benefits are awarded. The fact that Medicare is a federally administered program and its eligibilities are the same for all individuals, limits the extent to which variation in Medicare coverage can be used to identify individuals' responses

to the Medicare incentives in the DI program. Despite facing the same eligibilities, individuals may place different values on the Medicare coverage. The extent to which an individual values Medicare coverage likely affects his decision to apply for DI. However, the daunting task of accurately estimating the value of Medicare coverage for an individual, in conjunction with the potential correlation between the cash benefit incentives and the Medicare incentives in DI, raises a concern about the accuracy of the existing estimates of DI cash benefit effects. Medicare effects have rarely been accounted for in models estimating the effects of financial incentives on DI applications. Not being able to properly measure the Medicare effect likely subjects the DI application models to an omitted variable bias problem. This bias will be significant if there is a sizable correlation between the value of Medicare to the applicant and the cash benefit level for which he qualifies. This correlation is hard to test, making important the need to devise an empirical strategy robust to the existence of such a correlation. In this paper we propose a natural experiment to circumvent the above thorny issues. In particular, we focus on an age window between 62 and NRA in which Medicare coverage plays virtually no role in DI application decisions, and therefore we can more accurately estimate the effect of the cash benefits on DI applications. Next we discuss in detail all the above challenging issues and emphasize the advantage of our empirical strategy that bypasses them.

It is difficult to quantify the value an individual places on the Medicare coverage, which not only depends on his current state, such as health status, health care service utilization, alternative health insurance coverage, financial constraint, and taste for risk, but is also affected by his expectation about his state in the future, such as his expectations about the evolution of his health status, health service utilization, health expenditures and the possibility of alternative health insurance coverage, uncertainty about his future income, and possibly changing tastes for risk. Failing to account for these stochastic dynamic processes likely produces biased estimates about the attractiveness of the Medicare coverage for an individual, which if not properly separated from the interest in the cash benefit would contaminate the calculation of the DI benefit elasticity. However, these expectations about stochastic processes about health, health expenses and income are difficult to measure and predict. Lahiri et al. (2008) were the first to control for the Medicare value while estimating the cash benefit effect on DI applications. Using a Diagnostic Cost Group model developed by the Center for Medicare and Medicaid Services, Lahiri and his colleagues calculated the expected cost of medical care for Medicare beneficiaries under age 65 for 1991 and 1992, and then estimated the sensitivity of DI applications to the variations in average expected Medicare expenditures

across health conditions. Although creative, a weakness of this approach is the use of average expected Medicare expenditures for a person's health condition at a point in time to measure his Medicare value. For example, the Medicare value for individuals with cancer, or back problems, or mental/emotional problems is likely quite different if they were to take into account the future evolution of their health condition and the expected future flows of medical costs associated with their health condition. An extension of this flaw is that someone without a particular health condition would not put any value on Medicare, something obviously incorrect. Additionally, it is very likely that even if someone's health status is not generating a high cost right now it might be a pre-existing condition preventing this person from getting good or fairly priced insurance, therefore increasing his value for Medicare given the expectation of high costs in the future. Therefore, the study may have biased, likely downwards, the estimated value of the Medicare coverage and the subsequently estimated effect of the Medicare value on DI applications.

Moreover, not all variation in health insurance preferences is likely to be accounted for solely in terms of observable factors, as some literature has pointed out (e.g. Pudney, 1989). For example, an individual's taste for risk or insurance, which affects his preference for health insurance, is hardly measurable empirically.[10]

Not being able to properly measure the Medicare effect likely subjects the DI application models to an omitted variable bias problem. This bias will be significant if there is a sizable correlation between the value of Medicare to the applicant and the cash benefit level for which he qualifies.

The extent to which an individual values health insurance coverage may be correlated with his wage rate, and in turn his DI benefit amount which is linked to his earnings history, though the sign of the correlation is unclear. There may be complex selection into jobs with different wage levels involving different taste in health insurance coverage, time preference, attitudes to risk, or other unobserved factors such as health status, genetic risk factors, lifetime exposure to environmental risks, diet, etc., which are correlated with wage rates. Monheit and Vistnes (2006) suggest that individuals put different values on health insurance and sort into jobs with different wage rate

[10] Besides the fact that tastes for risks and health insurance may vary across individuals, an individual's preference for health insurance could also change over time, for example, from a time when he was healthy and sorting into jobs in the labor market to a time when he suffered from health shocks and decided about applying to a disability program. All these unobserved heterogeneity and uncertainties add to the complexity of properly controlling for health insurance preferences and thus the Medicare incentives associated with the DI program.

and health insurance coverage accordingly.[11] Blau and Gilleskie (2001) also point out that health insurance is likely endogenous because it is job characteristics and individuals choose a job taking the health insurance value into account; or workers choose a health insurance plan if their employers offer multiple plans. To the extent that an individual's expected value of health insurance coverage is correlated with job market outcomes and wage rates and therefore the DI benefits amount, the estimated effect of cash benefits on DI applications will be biased in a model without controlling for the health insurance (Medicare) values for individuals.

The direction of the omitted variable bias is ambiguous. If the extent to which an individual values health insurance is negatively (positively) correlated with wage rate and thus the DI benefits amount, the cash benefit effect estimated on DI applications would be biased downward (upward) in a model without properly controlling for the value of health insurance. For example, it could be argued that demand for health care quality may be a luxury good. Education likely helps people understand the benefits of health care and makes them aware of new technologies of treatment etc. So, given health status, the more educated (richer), probably value health insurance more than the less educated (poorer). On the other hand, poorer people are generally sicker, have less ability to self-insure, face more calamitous financial outcomes if they do get sick, and may have more physically demanding jobs that require physical health to perform. These latter considerations suggest the poor might value health insurance more.

These considerations raise a concern that the effect of the DI cash benefit would, to some extent, capture the effect of Medicare benefits if the latter is not properly controlled for. However, we also discussed earlier that it is very difficult to appropriately measure the value that an individual places on Medicare coverage. In this paper we design a natural experiment to circumvent these issues, by focusing on an age window between 62 and NRA in

[11] Monheit and Vistnes find that people with strong preferences for health insurance are more likely to hold a job with health insurance coverage, while those with weak or uncertain preference (who would prefer wage compensation to such in-kind benefits) are more likely to work in jobs without health insurance coverage. In reality, people with strong preferences for health insurance but low human capital (including health capital) may not be able to find a job with health insurance coverage, and people with weak or uncertain preference for health insurance and great human capital will most likely find a job that offers health insurance coverage or negotiate to turn the health insurance coverage into salary compensation. Interestingly, the income tax exclusion of health insurance and progressive income taxation reinforce this selection, which makes most estimates of DI cash benefit elasticity likely problematic.

which Medicare coverage plays virtually no role in DI application decisions, and thus estimating a cleaner cash benefit effect on DI applications.[12]

5. Identification Strategy

The relationship between retirement benefits and disability benefits, especially for individuals age 62 and above, provides us with a quasi-experimental scenario in which we can analyze the effects of an exogenous increase in comparative disability benefits for individuals who have retirement as an alternative. The key aspects of the Social Security reforms, passed in 1983 by the first Reagan administration, and implemented (in the case of the more dramatic measures) starting in 2000, do not directly affect disability benefits, but do affect the comparative attractiveness of disability with respect to retirement benefits. Using the cross-cohort variation in the relative attractiveness of DI benefits with respect to retirement benefits, we are able to study the DI application decision in response to (comparative) benefit changes as a result of the increases in the NRA and the penalty in early retirement benefits.

For cohorts born up to 1937 the NRA was 65, meaning that at that age individuals would receive 100percent of their Primary Insurance Amount (PIA), which is a piece-wise linear function of their Average Indexed Monthly Earning (AIME), which is a summary measure of the individuals' history of earnings. However, the reforms spearheaded by the Presidential Commission presided by Alan Greenspan, determined an increase in the NRA to 66 during the last decade (and eventually to 67 for those born after 1954) by increasing the NRA in increments of two months for each cohorts born after 1937. What this means is that for an individual considering applying for retirement and/or disability at age 62, the gain from receiving disability benefits was historically 20 percent of the PIA, because this was the actuarial reduction applied to the PIA for individuals claiming at the Early Retirement Age. However, for those born in 1938 who face an NRA of 65 and 2 months, the gain increases to 20.83 percent of

[12] Cash benefit incentives and the health insurance value could also be correlated in other ways. For example, Fronstin (2000) noted that DI cash benefits can be used by new awardees to purchase COBRA coverage during their two year waiting period for Medicare coverage. However, it should be clear that the cash benefit and in-kind Medicare benefit are not interchangeable, especially for the disabled. The Medicare coverage provided by DI program to the disabled may not be available in the market at any price or may not be affordable. Health insurers in the non-group market typically either exclude people with disabilities from coverage altogether or make such coverage extremely unattractive due to exclusions and limitations for preexisting conditions. While some of this will change with the implementation of the ACA, given limitations to adjustments due to age, and the inability to take into account pre-existing conditions (with the exception of smoking), the out-of-pocket and premium expenses will be difficult for most disabled individuals to afford, so that Medicare coverage will continue as the far superior option.

the PIA. For those born in 1939, who face an NRA of 65 and 4 months, the gain increases by another 0.83 percentage points (to 21.67 percent of the PIA). For those born in 1940, 1941, 1942, and 1943-1954, who face an increased NRA in an increment of 2 months, the gain increases gradually by 0.83 percentage point for every 2-month increase in NRA. Figure 2 summarizes the gains from receiving DI benefits compared to OA benefits for various birth cohorts facing different NRAs.

As Figure 2 illustrates, the comparative gains from applying for disability vary by claiming age. Given the nature of the calculation of retirement benefits, the increase in comparative benefits from applying for disability is a bit higher if claiming at age 63, 64, or 65 compared to claiming at age 62 (1.11 percentage point compared to 0.83 percentage point). So based on the age distribution of disability application for this age window, we compute a weighted average increase in the comparative attractiveness of disability, which, in conjunction with the estimated marginal effect on the application probability from a two-month increase in the NRA (i.e. one unit increase in the variable "NRA category") and the baseline application rate, would provide us an estimate of (comparative) benefit elasticity of disability application.[13]

Additionally, we revisit a long-standing question about the puzzling lack of interest in applying for the DI program once an individual has started to receive retirement benefits. Qualifying individuals can permanently increase lifetime Social Security benefits by as much as 25percent. Simple intuition suggests a low cost of applying for DI among those who have claimed retirement benefits, assuming once they have claimed OA benefits that they have a relatively weak attachment to the labor force and face little stigma from receiving DI benefits in retirement. The cost of the additional application for DI is small because they receive retirement benefit checks during the lengthy review period for their DI application. We find that receiving retirement benefits lowers the probability of applying for DI, suggesting that those who reach age 62 without applying for DI would expect to gain less from an application than a randomly selected individual, once we control for a variety of characteristics trying to capture the likelihood of applying to DI and the selection into not applying before age 62. The lower interest in applying for DI

[13] The realized gain from applying and being awarded disability is a function also of whether the person has been receiving retirement benefits. For example, if someone (born after 1943) applied for retirement benefits at age 62 (say in 2005), and then a year later got into SSDI while the onset of disability is determined to be on the same day, their benefits will not be adjusted from 75 percent of the PIA to 100 percent, but from 75 percent to 95 percent, to account for the fact that they have received retirement benefits for a full year. This makes even more critical the need to control for whether the person is receiving retirement benefits as we do in our work.

compared to OA may also be in part due to the less appealing DI program near the Social Security retirement ages, due to the access to Medicare at age 65 regardless of disability status.[14]

5.1 Younger Ages as a Possible Comparison Group

The identification mechanism regarding exogenous increases in benefits, also applies in principle to an estimation using younger individuals, with some of them belonging to the cohorts with the NRA above 65. However, we find this argument quite problematic because of the fact that the comparison between different types of benefits supposedly happens years before it is relevant. How likely do we think is a 55-year-old to apply to DI or not because he knows that seven years from now the benefit received will be 25 percent higher than what he can get through the OA benefits system? Additionally, for this younger cohort access to Medicare could be important, therefore the estimation with a younger sample (something done by most previous researchers) is likely to pick up a combination of a pure cohort effect (also present for the older sample) and an heterogeneous preference for Medicare by cohort, which could be the result, for example, of differential expectations of health care expenditures, while not picking up much of the exogenous variation in benefits for younger cohorts.

What this means is that the interpretation of the estimates of the key NRA-Cohort variable using younger individuals is quite different than for older individuals. For those in their fifties the key parameter estimates are a likely combination of heterogeneous preferences for Medicare by cohort and a pure cohort effect perhaps the result of differential stigma effects with respect to DI applications by cohort. For older individuals, which represent our preferred sample, the interpretation of the parameter estimates of our key variable of interest is that of an exogenous increase in benefits combined with a possible pure cohort effect, again maybe the product of differential stigma effects by cohort.

Ideally we would like to separate the effect of the exogenous variation in in benefits from the pure cohort effect but this would only be possible if we could estimate the application decision for a younger sample, but without incentive to acquire Medicare. One hope for the latter is to restrict attention to SSI recipients who can

[14] We are assuming that individuals at these older ages have knowledge about the sometimes-competing and sometimes-complementary OA and DI incentives. If educational attainment could, to some extent, indicate how much information an individual has about the interacting OA and DI incentives, we have in the regression interacted the two terms, receiving OA benefits and education attainment, and found no major difference between people with different education attainments in their decisions to apply for DI once they have started to receive OA benefits.

consider applying for SSDI if eligible, since for them the Medicare incentive would not be present given that they already receive Medicaid. Unfortunately, such a special sample is too small in our dataset. An alternative to such sample could be a younger group with any public health insurance coverage (excluding Medicare because younger individuals most likely get Medicare through DI program and they are not at risk of applying for DI anymore), for whom the health insurance incentives associated with DI program are not present. Given data limitations we have to accept that our preferred estimates include a possible pure cohort effect in terms of preferences for DI. Additionally, as a sensitivity analysis we will also pool all our ages, as yet other researchers have done, even though it is unclear those estimates provide for an easy interpretation.

Notice that given that the incentives faced by the "older group" (age 62-NRA) and the "younger group" (age 51-58) are very different due to the existence of Old Age benefits and Medicare, it would be inappropriate to apply a more standard difference-in-difference approach.

6. Data and Empirical Model

6.1 Sample Construction

We use the ten available waves of the Health and Retirement Study (HRS), which cover the1992 to 2010 period. The HRS is a biennial national representative survey and it interviews individuals born between 1931 and 1941 and their spouses, as well as additional cohorts that have been added in recent waves. The data provides extensive information on health status, employment history, wealth, income, family structure and government program participation and transfers for a total of 30,672 respondents.

The HRS contains detailed information about the respondents' DI application process. For example, it asks questions about whether the respondent has applied for disability benefits from the DI program, when he applied, when he appealed (if the initial application was rejected), when he started receiving and stopping receiving benefits, and the benefit amount received. We assume that each individual decides whether to apply for DI program in each wave. If he did not apply, we set the decision date to the interview date. If he did apply, we set the decision date to the reported date of the initial application (in contrast to the date of appeal). We exclude individual observations already receiving DI benefits or having a pending application (including appeals). An individual can apply for DI benefits multiple times. After the DI benefits from a previous application were stopped, or an application was

ultimately rejected (after appealing if one chose to do so, or two years have gone by without any additional identifiable appeal), an individual decides whether or not to start a new application. We include in the sample all the observable DI applications during the study period.

We examine the effect of an individual's health, financial, and demographic variables in period *t-1* on his decision to apply for DI between period *t-1* and *t*, where one period is a two year span. We matched each decision with the individual's characteristics observed from the most recent interview wave before the decision. We do not prefer the contemporaneous measure of an individual's characteristics because generally an individual has already dropped out of labor force to become eligible by the time he applies for DI.[15] Using contemporaneous measures, especially employment related variables such as work status, earnings, and work related health insurance coverage, could lead to biased estimates of the effect of those variables on the application decisions.

Our main study sample is made up of observations between age 62 and NRA (varying from 65 to 66 depending on birth cohort), which is used to study the decision to apply for DI at age 62 to NRA based on an applicant's most recent characteristics before applying. We include birth cohorts 1931-1944 which faced NRA ranging from 65 to 66 in two-month increments. In the data, we observed these cohorts' whole experience from age 62 to their NRA. In other words, the sample is not truncated for our purpose. We also construct a sample a little bit younger, from the same birth cohorts, to examine an individual's application decisions at age 51-58 given his status in the previous period. This younger group serves as a kind of comparison group. For them, a similar estimation is conducted to the one for the main sample (age 62-NRA), which can provide us with results more likely to be contaminated by the demand for Medicare insurance which can bias our estimates of the DI benefit elasticity. The younger sample is left truncated; that is, some individuals in the sample may have applied for DI benefits and some already received the benefits before we first observe them. We will control for the initial condition, that is, the sample selectivity of DI status when they enter the sample. Details on the estimation of the older and the younger samples are provided in Section 5 as we discuss in detail the identification strategy and methodology.

One potential problem with the HRS is that it does not explicitly differentiate between the two public disability transfer programs, the DI and the Supplemental Security Income (SSI) program until wave 5 (year 2000). The two programs apply the same disability definition in the determination process. But unlike the DI program, the SSI

[15] Our estimation using contemporaneous measures of individuals' characteristics does not alter the results significantly.

program offers Medicaid coverage immediately requiring no waiting period (at least in most of the states) as an application is approved, and the type of clientele of the SSI program is very different since it does not require any kind of work history, and offers much lower benefits. Our research strategy does not work for SSI applications. When constructing the sample, we restrict attention to DI applications whenever possible through use of other available information in the data such as information on employment, disability, and income.[16]

The time aggregation is an issue endemic to almost all the DI studies using panel data. For example, in the HRS, respondents were observed at points in time that are approximately two years apart, although individuals decide whether and when to apply for disability on a more frequent basis. The wider the time window over which we observe any individual, the more likely he will apply for disability. The number of observations of applying or not applying disability for a single individual, and therefore the application probability is to some extent arbitrary and depends on how finely we discretize time. Given that we observe most individual characteristics in the HRS only every two years, we discretize time into two-year intervals.

6.2 Descriptive Statistics

In Table 1, we compare the observed characteristics of individuals aged 62-NRA who were born in or before 1937 and face the historical NRA of 65, with that of individuals aged 62-NRA who were born after 1938 and face the increased NRA, just prior to their decision making about DI applications. We present in the last column of Table 1 the mean difference between the younger cohorts and the older cohorts in an array of socio-economic and demographic characteristics. In general, among the individuals at ages between 62 and NRA, those born after 1938, compared with those born in or before 1937, are more educated, report worse health, have different health insurance coverage (more coverage from work and long-term care insurance, and less coverage from government), utilize more medical services, have higher out-of-pocket medical expenditures, higher income and wealth, longer work history, more white collar occupation, and include more residents in the west region.[17] The younger cohorts who face increased NRAs are two times more likely to apply for DI than the older cohorts who face the NRA of 65 and this (unconditional) difference is highly statistically significant.

[16] We have also re-estimated our main specifications restricting attention to data from wave 5 to 10, and the main results do not change in significant ways, but the number of observations drops considerably and the overall fit of the model is not as good.
[17] The average age in the younger cohorts is higher than that in the older cohorts, mainly because of the higher NRA for the younger cohorts.

Table 2 summarizes the characteristics of DI applicants of age 62-NRA, comparing the older cohorts (born<=1937) and the younger cohorts (born>=1938). Compared with the description in Table 1about the whole cohorts (both older and younger cohorts) in this age range, it is not surprising that the subgroup of DI applicants, in all the cohorts, are generally worse off in terms of health and economic status. Detailed comparison between applicants and non-applicants will be presented later in Table 3. In Table 2, the DI applicants from the younger birth cohorts, for whom the NRAs are increased and thus DI benefits are comparatively more attractive than retirement benefits, are slightly younger when they apply, and include more females, more whites, more married individuals, and more college graduates. They report more functional limitations and health conditions but give better overall assessment about their health status. They are significantly more likely to be covered by health insurance through their spouses' work, but much less likely to be covered by government provided health insurance. They are much more likely to have stayed in a hospital or visited a doctor in the previous year. Their out-of-pocket medical expenditures double those of the DI applicants from the older cohorts. Their earnings before they leave work and apply for DI are lower but their other household income and wealth are higher than the applicants from the older cohorts. They are more likely to have longer work history and white collar occupation. They are a bit more likely to live in the West and the Midwest.

Table 3 presents the comparison of DI applicants and non-applicants at ages 62-NRA. It is interesting to emphasize that applicants are much more likely to belong to the cohorts for whom DI benefits are comparatively more attractive than retirement benefits, with 66 percent belonging to these cohorts, while the percentage is only 50 percent among non-applicants. Among applicants, 19 percent are already receiving OA benefits, compared to 32 percent among non-applicants. Applicants on average, are slightly younger than non-applicants, possibly due to the fact that both cash and Medicare incentives becomes weaker as one gets older. There are slightly more males, more non-whites, fewer married, and more low educated individuals among applicants than non-applicants. The proportion of applicants who report work limitations is three times that of non-applicants. As high as 46 percent of applicants report to be in fair or poor health, compared to only 14 percent among non-applicants. In addition, we also pay attention to self-reported health changes as recommended in Benítez-Silva and Ni (2008). There are 39 percent of the applicants who report that their health got worse since the previous wave, while only 14 percent of the non-applicants report worse health.

Additionally, 44 percent of applicants report difficulties in Activities of Daily Living (ADLs) while only 7 percent of non-applicants report ADLs difficulties. There are also more major differences in the health conditions reported by applicants than non-applicants. The health insurance coverage rate among applicants is 83 percent, very similar to the coverage rate, 86 percent, among non-applicants. Applicants are more likely to be covered by government provided health insurance while non-applicants are more likely to be covered by employer (their own or spouse's employer) provided and other health insurance. As could be expected applicants report more doctor visits and hospital stays, and their average out-of-pocket medical expenses are higher than those of non-applicants. The total household net worth of non-housing wealth among applicants is less than one-third, and the household income is about 40 percent less than that of non-applicants. Applicants tend to have a slightly longer work history than their non-applicant counterparts, and much less likely to have work in white collar occupations. The distribution of the regions of residence is quite similar between applicants and non-applicants except that a slightly higher proportion of applicants come from the South.

As a comparison, we also look at the cohort contrast at younger ages. Table 4 summarizes the observed characteristics of individuals at the age between 51 and 58, and compares those born in or before 1937 and those born in or after 1938. It is interesting to emphasize that there is no significant difference in the DI application rate among the earlier cohorts that face the traditional NRA and the later cohorts that face increased NRA. In general, among the younger cohorts aged between 51 and 58, there are 11-percentage-point more female, slightly more non-whites and married, and about 20 percent more college graduates. In terms of health status, significantly higher proportion of people from the younger cohorts report worse health since the last wave compared to the proportion in the older cohorts. The younger cohorts also generally report more major health conditions than the older cohorts. The younger cohorts are less likely to be covered by government provided health insurance but more likely to have long-term care insurance coverage. They report more hospital stays and doctor visits in the previous year and higher out-of-pocket medical expenditures. Their other household income than individual earnings is significantly higher than the older cohorts. They are more likely to be working two years ago (i.e. the last wave of interview) compared to the older cohorts. They have shorter work history on average than the older cohorts but more likely to work in white collar occupations. The distribution of residence regions is not very different except that the younger cohorts are a bit less likely to live in the Northeast.

In Table 5, we compare the observed characteristics of DI applicants between the younger cohorts and the older cohorts at the age between 51 and 58, just prior to their decisions about DI applications. The applicants from the younger cohorts are less likely to be male or married, and more likely to be non-white and college graduates. They are more likely to report worse health since the last wave and report more major health conditions. They have less government provide health insurance or coverage through spouse's employer, and more coverage from work and long-term care insurance. But the changes in health insurance coverage between cohorts are not statistically significant. The applicants from the younger cohorts on average report more hospital stays. They also report lower household income in the previous year.

In addition to comparing individuals' characteristics by cohorts, we also pool the cohorts together and compare DI applicants and non-applicants at ages 51-58 (Table 6). Compared to non-applicants, applicants are more likely to be non-white and less educated, and less likely to be married. They are more likely to report more health limitation, fair or poor health, health getting worse since the last wave, more difficulties in ADLs, and more major health conditions. The applicants are more likely to have government provided health insurance and less likely to be covered by employer provided health insurance than non-applicants in the wave prior to their application decisions. There are significantly more hospital stays and doctor visits and higher out-of-pocket medical expenditures reported by applicants than non-applicants before their application decisions. They have lower income and wealth on average than non-applicants. They are less likely to be working the wave before their decisions about DI applications. They are less likely to work in white collar occupations. They are much more likely to reside in the South than non-applicants.

6.3 Econometric Specification

The dependent variable, DI application decision, is a binary variable and can be modeled in terms of a continuous latent variable, Y_{it}^*:

$$Y_{it} = l(Y_{it}^* > 0) = l(X_{i,t-1}\beta + \varepsilon_{i,t-1} > 0)$$

where $l(.)$ is a binary indicator function. This is motivated by the assumption that the observed application behavior at time t is determined by a continuous latent variable Y_{it}^*, ranging from -∞ to ∞, which can be thought of as an individual's propensity or tendency to apply for disability, and is a function of individual characteristics ($X_{i,t-1}$)

and an error term ($\varepsilon_{i,t-1}$). The unobserved application tendency and the observed application behavior are linked the following way: Individuals with positive values of Y_{it}^* are observed as Y_{it}= 1, where individuals with non-positive values of Y_{it}^* are observed as Y_{it}= 0.

The idea of a latent Y_i^* is that an underlying propensity to apply for disability generates the observed behavior. Some people have stronger tendency to apply for disability, some have weaker inclination to apply, and still others would never consider applying or even have some prejudice against it. We imagine an underlying continuum of tendency to apply for disability, with each individual having some value on this continuum or taking some value of Y_{it}^*. Although we cannot directly observe the underlying propensity to apply, at some point a change in Y_{it}^* results in a change in what we observed, namely, whether an individual applies for disability. Y_{it} is a dummy variable indicating whether an individual *i* applies for disability benefits (between time *t-1* and *t*). Those individuals whose value of Y_i^* is positive and who are more inclined to apply are observed to apply for disability (that is, $Y_{ti} = 1$), and those whose value of Y_{it}^* is zero or negative and who have weaker tendency to apply or have negative feelings about applying are not observed to apply.

On the right hand side in our specifications, the main variable of interest is a time-invariant birth cohort indicator, NRA category. It is constructed as a categorical variable that takes seven values. It equals 0 if a person belongs to the birth cohort facing traditional NRA of 65, and equals 1 to 6, depending on whether the NRA faced by the birth cohort is 65 and 2 months, 65 and 4 months, 65 and 6 months, 65 and 8 months, 65 and 10 months, or 66. For an individual born after 1937 and facing an NRA above 65, DI benefits are more attractive, compared with older cohorts, than retirement benefits.

Other elements in the vector $X_{i,t-1}$, are an array of factors measured at time *t-1* that possibly affect an individual's disability application decision between time *t-1* and *t*. These factors include health status, socio-economic status, demographic variables, and regional indicators. We include a rich set of health status controls: whether to have health problems that interfere with work ("health limits work"), self-rated fair or poor health ("fair/poor health"), self-assessed health changes ("health gets worse" and "health gets better"), number of reported difficulties in Activities of Daily Living ("number of ADLs"), and number of major health conditions that have been diagnosed ("number of major health conditions").

Also included as regressors, are income and wealth variables, such as income earnings in the last year, other household income last year, and net worth of non-housing wealth. These variables are included to account for the individual's budget constraint.[18] Work history variables are included in the model, such as whether working for pay before DI application decision ("working for pay"), total number of years worked, and whether in white collar occupation in the longest held job ("white collar"). On the one hand, these variables can provide information on an individual's job prospect based on his work experience and occupational status, and therefore proxy for an individual's opportunity cost if he applied for disability. On the other hand, these employment history variables can proxy for the work eligibilities for the DI program that requires long enough (proxied by the total number of years worked) and recent enough (proxied by the indicator of working for pay just before DI application) work history.

The status of health insurance coverage and medical care utilization and expenditures are included to capture to some extent the health insurance incentives to apply for DI benefits. But as discussed earlier, it is hard to measure the health insurance preferences only by observable variables. In addition, given the fact that many applicants would be without any health insurance during the statutory two-year waiting period for Medicare coverage in the DI program, whether having alternative health insurance coverage may affect the decision to apply for DI (Autor and Duggan, 2006; Gruber and Kubik, 2002) is unclear.

Regional dummies are included to capture the variation across country in DI program stringency (Coe et al., 2011) and local economic conditions (Rupp and Stapleton, 1995). Ideally, we would also include in the regression the year indicators to capture the macroeconomic conditions that are correlated with the decision to apply for DI (Autor and Duggan, 2006). But we cannot identify the year effect in a regression that simultaneously control for age effect and cohort effect. We have included the year-specific unemployment rate in the regression, but we found that it has no significant effect on DI applications.

An additional variable of interest in our estimation, $Rec\_Ret_i^{t-1}$, is the indicator for whether the individual is already receiving retirement benefits for the age 62 to NRA sample. This indicator does not exist in the estimation specification for the age 51-58 sample for whom retirement benefits are not available yet based on their own earnings history. In principle, it could be considered optimal to apply for disability after receiving retirement

[18] The variable, income earnings last year, is for one period only. So it may not be a good measure of an individual's typical earnings level. Alternatively, we include a moving average of an individual's earnings in the estimation, and results are not affected much.

benefits if they are not able or willing to work much, given the fact that disability will provide much higher lifetime benefits, the exact level of which will be a function of the time of application and receipt of benefits. The delays and uncertainties involved in the DI application process could constitute a great hassle cost. This cost is significantly lower for those over age 62 and already receiving retirement benefits, because they have alternative benefits (although lower) to rely on while waiting for their DI application results and/or when their application get rejected. Once their application gets approved, their retirement benefits will be increased to the DI benefit level. In that sense, the DI benefits and OA benefits are complementary.

But in reality, not many people take advantage of this path. Most likely people see DI benefits and OA benefits as substitutes, that is, they decide to apply to either the DI program or the OA program but not apply to both simultaneously. We have observed some unadjusted statistics in Table 3 that only 19 percent of the DI applicants are already receiving retirement benefits. Benitez-Silva et al. (1999) cited informally a similar "interesting puzzle" noted by Peter Diamond: "Why do more people not simultaneously apply for early retirement and DI benefits?" However, it is hard to empirically test the potential explanation for this puzzle: the hassle cost, the stigma cost and the informational cost of submitting a DI application exceeds the expected utility from the extra 20-25 percent benefit margin. Without means of properly modeling the above costs associated with DI application, our empirical model does not try to solve the puzzle but can only confirm the existence of the puzzle that individuals seem to see OA and DI benefits as substitutes, and those already receiving OA benefits are less likely to apply for DI benefits (Table 7).

The effects of any other unobserved individual characteristics and possible measurement errors are included in an error term, ε_{it}. The probability of applying for DI benefits depends on the distribution of the error term. If we assume that ε_{it} follows a normal distribution with mean zero and variance one, it leads to a binary probit model.[19] The marginal probability of applying for disability at time *t* is given by the standard normal cumulative density function of the error term, $\Phi(.)$, conditional on the independent variables:

$$\Pr(Y_{it} = 1 | X_{i,t-1}) = \Phi(X_{i,t-1}\beta)$$

[19] Alternatively, the error term ε_i can be assumed to follow a logistic distribution, leading to a binary logit model. Our results are not significantly different under the logit specification.

If we assume that the error terms ε_{it} are independent over t, we could just apply the standard cross section probit estimator or the pooled probit model. The log-likelihood would simply be the product of the marginal distributions. Given the fact that there are repeated observations for the same individual in the sample, it is possible that observations are in fact correlated within individuals. In that case, the joint distribution in the log-likelihood function for the pooled model will be mis-specified and hence the estimates will be biased. For that, we could simply correct the standard errors using sandwich estimates that are robust to clustering within individuals. In the results section, we will show the estimates from the pooled probit specification with standard errors adjusted for clusters in individuals.

Using panel estimators can be problematic if the panel is too short and there are only a few observations per individual. Lacking variation over (such a short) time in almost all the variables, the model would show extremely high degree of persistence and attribute most of the variations in DI applications to the unobserved individual effect. In this study, we look at how an individual's decides to apply for DI benefits in period t based on his status in period t-1, over a small window of age from 62 to NRA. Our sample include 8,134 unique individuals, 20 percent of whom are observed only once moving from period t-1 to period t, nearly 41 percent are observed twice in the transition, about 39 percent observed three times and less than 1 percent are observed four times. With the short panel, we decide that it is not appropriate to apply panel estimators here. The nature of the problem under study is actually similar to considering the hazard of applying for DI benefits. However, it is not proper to apply the hazard model to fit the data, which would not be able to capture the slower rate of DI application near the NRA.

Our research question focuses on DI applications after age 62. The timing (for example, before age 62 or after) of an individual's DI application decision could be endogenous. The initial observations in our sample containing individuals at age 62 and older are not exogenous if the error process concerning the DI application is not serially independent. In other words, the unobservables determining DI applications/receipts before age 62 and after age 62 may be correlated, and restricting the sample by age may constitute an endogenous selection. For example, the individuals who attach stronger stigma to DI applications especially at younger ages may choose to apply at an older age possible. It is also possible that the individuals who are very risk averse and have stronger preference for health insurance coverage would choose to apply as early as possible. All such preferences or attitudes are hard to measure with observables. Failing to account for the endogenous sample selection through various timing of DI

application may result in misleading estimates of the relationship between the DI application and its determinants. Thus a consistent estimation of disability application equation requires a control for the initial condition of not having already received DI benefits by age 62.

This control is implemented by estimating a Heckman selectivity correction type of equation with the dependent variable being not having already been on DI by age 62, jointly with the DI application equation. By explicitly allowing for correlation between the error terms, we account for the possible selectivity bias resulting from the sample construction. Specifically, our sample contains a non-eligible proportion of individuals who already receive DI benefits by age 62. Thus their corresponding observations cannot be used when estimating the DI application equation for age 62 and above.[20] We use a variation of the Heckman two-step method to control for selectivity bias. In the first step, we use all the observations, including those who already receiving DI benefits and thus are not eligible (necessary) to apply, and estimate a probit model where the dependent variable is "not already receiving DI benefits by age 62". We calculate the inverse Mills ratio for each observation. In the second step, we use the selected sample (our main sample), all the observations who are not already receiving DI benefits by age 62, and estimate a probit estimation in which the dependent variable is whether to apply. By including the inverse Mills ratio as an additional regressor, we correct for the sample selectivity. This will give consistent estimates of the parameter vector β, and the standard errors in the second step are adjusted for the inclusion of the predicted inverse Mills ratio.

Another potential problem with the specifications discussed so far, is that the factors that affect decisions to apply for DI may be associated with decisions to claim OA benefits as well. The simultaneity of these two decisions can lead to the endogeneity of the measure of whether the individual is receiving OA benefits. To account for this possibility, we estimate bivariate probit models. First, in the recursive bivariate probit specification, we assume that OA and DI decisions are made sequentially and receiving OA benefits affects DI application decisions. In the seemingly unrelated bivariate probit model, we assume that DI and OA decisions are simultaneously made and the error terms in the two equations are correlated. In both bivariate probit specifications, an excluded variable from the equation for OA claiming is whether one plans to work after age 62. If an individual plans to work after

[20] In principle, a DI recipient is eligible to apply again once he leaves the roll for various reasons (such as health improvement and/or return to work). However, in our sample, virtually none of the DI recipients leave the roll after age 62 except a few permanent attrition cases.

age 62, it is unlikely that he would apply for DI after age 62 because working would disqualify him for DI benefits. Working after 62 does not conflict with claiming OA benefits though. Individuals can still work after claiming OA benefits.[21]

7. Estimation Results

7.1 Main Results for the Older Group

In Table 7, we present the probit estimation results for several alternative specifications, showing the average marginal effects and standard errors of the DI application for the sample of individuals in the age 62 to NRA range. We provide in the table the Average Marginal Effects (AME), which instead of evaluating the marginal effect at the means of the exogenous variables, averages out the marginal effects at the actual values of the variables in the sample. We have also calculated a second set of marginal effects which is more commonly reported Marginal Effects at the Means (MEM), which evaluates the effects keeping the other variables at their means. The second set of marginal effects is not shown in the paper due to space limit. Even though asymptotically AME and MEM are in principle equivalent, in the presence of a large number of binary regressors it has been observed that they can provide fairly different results, being the MEM more problematic (see Bartus, 2005 for a recent discussion). While the marginal effects reported are quite different depending on which calculation is applied, the key interpretation of our results in terms of elasticities is almost unaffected by this distinction.

The columns in Table 7 are separate regressions with model specifications of pooled probit, pooled probit with Heckman selectivity correction, recursive bivariate probit, and seemingly unrelated bivariate probit. In all the specifications, we include a rich set of demographic, health, and financial variables. We do not include the year effects because we believe the inclusion of time dummies is problematic due to the lack of identification of age, cohort (the variable "NRA category"), and time effects in any panel analysis. Notice that we already restrict attention to a very narrow age group who belong to very close cohorts, and therefore time effects are unlikely to be separately identified.[22]

[21] Individuals' earnings are subject to earnings test after they claim OA benefits. For details, see Benítez-Silva and Heiland (2007, 2008).
[22] We also tried to include forward looking variables, as those by Kreider and Riphahn (2000), such as predicted award probability and predicted benefit amount. The regression results are almost not affected. But including those variables can be problematic, since their estimation outside the model requires hard to test and justify, exclusion restrictions, to obtain non-parametric identification of the coefficients.

Our main variable of interest, NRA category, the indicator for belonging to the cohorts born after 1937, for whom DI benefits are comparatively more attractive, has a positive and statistically significant effect on the DI application decisions, in all the specifications. The size of the effect is fairly stable in all specifications: a two-month increase in NRA is associated with an increase in DI application probability ranging from 0.10 to 0.12 percentage points. It implies a benefit elasticity of application between 0.86 (based on recursive bivariate probit model) and 1.02 (based on heckman probit model). The elasticity calculated based on results from pooled probit model (0.90) and from seemingly unrelated bivariate probit model (0.88) are within the range.[23, 24] We also control for Heckman sample selectivity in the two bivariate probit models, and there is little impact on the results.

In the model of pooled probit with heckman selectivity correction, the correlation coefficient *rho* is negative (-0.27) between the main equation (DI application) and the selection equation (not receiving DI benefits by age 62), suggesting that unobserved factors that affect people receiving DI benefits before age 62 are negatively correlated with the unobserved factors that affect their decisions to apply after age 62. We interpret the statistical significance of the correlation coefficient as evidence of endogenous sample selection. In this case, the timing of applying for DI is endogenous.

The correlation coefficient *rho* between the error terms in the DI application equation and the OA receiving equation is statistically significantly different from zero in both bivariate probit specifications, implying that the two equations are jointed determined and that unobservable factors that influence the probability of receiving OA benefits also influence the probability of applying for DI. Note that *rho* is positive in the recursive bivariate probit model but negative in the seemingly unrelated bivariate probit model. In the model with recursive bivariate probit specification, we find that an individual who is already receiving OA benefits is 3.2 percentage-point less likely to apply for DI, while unobserved factors (e.g. tastes for work/leisure) that influence OA receipt and DI application

[23] The qualitative nature of the results is basically unaffected if we use the MEM measure to present the marginal effects, but quantitatively the differences are quite large, with all the marginal effects much smaller.

[24] We also estimate the model by excluding the married women from the sample. One concern is that the labor force participation rates may vary across birth cohorts (for example, the labor force participation has increased substantially among women in recent decades, including those in this age group, with females in the age 60 to 64 group increasing their labor force participation from around 33 percent during most of the 1980s, to 39 percent in September of 1999, to 50 percent in September of 2012), which may result in differential DI insurance status and thus differential proportion of individuals eligible for DI benefits in terms of the total number of quarters of coverage accumulated throughout their work life. Since we cannot directly control for eligibility, it could very well be that we are interpreting the increased likelihood of an application for DI as linked with cohort effects with higher interest in disability because of the changes in the NRA when it is really linked with eligibility thanks to a higher attachment to the labor force. Using HRS data from 1992 through 2008 merged with the SSA earnings records, Coe and Haverstick (2010) tested this concern for individuals at age 55 and found no clear trend in insurance rates by birth cohort except for married women. On the other hand, the concerns about eligibility measures and the likely application behavior of those 62 and over, goes back to Leonesio et al. (2000). So we re-estimate our specifications excluding married women, which seem the only problematic group given our assumption of eligibility among the sample we use. The results are quite similar.

are positively correlated. In the model with seemingly unrelated bivariate probit specification, *rho* is negative, a combination of the negative effect of already receiving OA on DI application and the positive correlation between the unobserved factors in the OA and DI equations.

The effects of the large array of additional factors that we control for in the regression are in general stable across specification and have the expected signs. Of particular interest is the result regarding the indicator of already receiving OA benefits, which has a significantly negative effect on DI applications. This is somewhat puzzling as some other researchers have also noted (Benítez-Silva et al. 1999), considering that in principle the opportunity cost of applying for DI while receiving OA benefits is almost zero if the person is not planning on continuing to work above the Substantial Gainful Activity level, and the result of getting DI benefits is a permanent increase in benefits. Specifically, an individual will receive larger amount of benefits for life if his application to DI is approved. If rejected, he will keep receiving the OA benefits. In addition, his OA benefits are not affected while he is applying and waiting for the DI determination. DI benefits, if awarded are affected by whether the individual has been receiving OA benefits, so the increase in benefits once they are awarded DI benefits is not to the level of 100percent of the PIA but 100percent minus a certain percentage per month of OA benefits received.

The possible explanations for individuals not taking advantage of the opportunity, other things equal, could be the hassle or stigma costs of submitting a DI application, or simply lack of information about this option once they have had access to OA benefits. Two GAO reports (1999, 2010) suggest that the relatively easier option of claiming OA benefits (compared to the lengthy and complex DI application process, which includes medical screening) might prevent people from applying for DI after they reach the ERA.

The coefficient for age is negative in most specifications and statistically significant in half of the specifications, indicating that as age rises from 62 to get closer to NRA, the attractiveness of DI benefits is declining comparative to OA benefits and thus the probability of DI application is lower. In line with the previous literature, non-whites and less educated individuals are more likely to apply. Married individuals are less likely to apply. As expected, having health limitation has a large positive effect on the application decision, a classical result in the DI literature, so does the self-reported fair/poor health. Individuals who report health getting worse, more difficulties in Activities of Daily Living (ADLs), and more major health conditions are more likely to apply and the effects are all statistically significant. However, being covered by health insurance does not appear to have any

significant effect on DI application decisions. Neither does doctor visits or out-of-pocket medical expenditures, but hospital stays are positively correlated with DI applications. Interestingly, Table 8 (discussed later) shows that in the estimation results for the younger group (ages 51-58), being covered by health insurance from own work significantly lowers probability of applying for DI. In contrast to the non-effect of alternative health insurance coverage for the older group, this effect for the younger group may capture in part the effect of Medicare incentives in the DI program on DI applications.

Having recently worked for pay positively affects the decision to apply for DI although the effect is not always statistically significant across specifications.[25] We consider this variable to potentially proxy for the work recency eligibility for DI benefits. The total number of years worked also has a positive and statistically significant effect on DI applications. This variable probably proxies for individuals' quarters of coverage eligibility for DI benefits. In the DI determination process, applicants are evaluated whether they can perform past or other work based on their work experience in addition to other factors. So it is important to control for what type of job an individual does in his employment history. The variable of being white collar is controlled for this reason. An individual is defined as white collar if his occupation in his longest held job reported requires managerial or professional specialty. We find that white collars are less likely to apply for DI and the effect of this variable is statistically significant in all the specifications.

We control for regions of residence and expect to capture some possible effect of local economic conditions and local SSA office's generosity on individuals' application decisions, but do not find statistical significant effect of the region variables.

7.2 Results for the Younger Group

Interesting as these results are, since they provide a fairly clean measure of increase in cash benefits free of Medicare incentives issues, something others researchers did not consider, they share a problem with those presented by previous researchers using the same identification source which exploits the exogenous increase in the appeal of disability benefits with respect to retirement benefits. The shared problem so far is that it is impossible to

[25] DI applicants need to have worked about five years in the recent ten years to be eligible for benefits. In particular they need 20 quarters of coverage in the last 10 years, which is about 5 years of work. Individuals older than 62 become fully insured with 40 quarters of coverage, or 10 years of work during their career, but they still need to have worked recently enough to qualify for DI.

identify the effect of belonging to those born after 1937 from a pure cohort effect, which could potentially explain an increased interest in applying for disability benefits. What this means is that the marginal effects we have computed could indicate just that younger cohorts value DI more, irrespective of the fact that it provides a better deal than for previous cohorts, compared with retirement.

One hope could be to look at individuals at a bit younger ages for whom the increases in comparative benefits matter little or not at all given the yet unavailable OA benefits, and for whom the pure cohort effect would also be present. However, for the younger ages the Medicare incentives come into play, and any differential appeal by cohort with respect to this program would be mixed with the pure cohort effect, making the results hard to compare to those of our main sample (age 62-NRA). It is hard to control for the Medicare incentives explicitly in the model as we discussed in Section 4.2. Thus the marginal effect calculated for the cohort variable "NRA category", likely picks up the Medicare incentive effect by cohort, that is, how differential appeal by cohort with respect to the Medicare program affect a cohort's DI application propensity. This coefficient would also capture a pure cohort effect (e.g. possibly smaller stigma attached to receiving disability benefits for more recent cohorts) if there is any. We present in Table 8 the estimation results on a younger group of individuals aged 51 to 58, for whom both cohort effects and Medicare incentives could be present when considering their application to the DI program. In addition to pooled probit model, we also correct for sample selectivity due to possible endogenous timing of DI application (those not receiving DI benefits by age 51 and entering our younger sample might be a selected group).

We find that for people of age 51-58, the indicator of belonging to a later birth cohort, for whom disability is more attractive in comparison with retirement (in the near future), does not have statistically significant effect on DI applications. Although the confounding effects of Medicare incentives do not allow us to identify a possible pure cohort effect, at least the different results in Table 7 and 8 suggest that it is inappropriate to pool the older age and younger ages together.[26]

[26] Seeking alternative approach to possibly identify a pure cohort effect, we have tried to examine the DI application behavior of the group at age 51-58 who have government provided health insurance coverage. We exclude from the sample those who have Medicare coverage, because these younger individuals get Medicare mostly through DI program and are probably not at risk of applying to DI any more. The possible pure cohort effect is estimated to be lower than the marginal effect of the cohort variable in Table 7. However, the estimation lacks power and we do not report the results here. We also looked at an alternative sample - SSI recipients who have received Medicaid coverage. They apply for DI not likely driven by health insurance (Medicare) incentives. However, such sample is too small to be helpful.

The coefficients of the other regressors in the estimation for this age group all have the expected signs. The marginal effects of these variables are in general similar in magnitude to the ones observed for individuals at age 62-NRA. The exception is the coefficient of the variable "covered by health insurance from own work", which is positive and insignificant for the sample at ages between 62 and NRA, but is negative and highly statistically significant for the sample at younger ages. It could be associated with the different incentive structures in the DI program for individuals younger than age 62 and those at and older than age 62. For the younger, both financial incentives and Medicare coverage incentives in the DI program attracts applications, and having alternative health insurance coverage would lower the propensity to apply. For those at and older than age 62, Medicare coverage incentives in the DI program are virtually not existent, and so it is not surprising to see no effect of alternative health insurance coverage on DI applications.

We also conduct similar analyses focusing on the 2000 to 2007 period (Table 9), mainly because the subsequent period up to 2010 is heavily influenced by the Great Recession and one concern is that our estimation using data 2000-2010 may be contaminated by the recession effect. We find that the results are mostly unaffected.

8. Conclusions and Discussion

The cash benefit elasticity is an important policy parameter. It helps evaluate the effect of policy changes in the disability programs and other programs that affect the appeal, relative to other sources of income, of the financial benefits in the DI program. Our analysis of the DI application response to benefit levels sheds new light on the effect of DI cash benefit, and could help policy makers gauge the effect of possible reforms to the disability programs, but also to understand the effects on the DI program of unilateral changes in the retirement program.

This study takes advantage of a special age window, age 62 to the NRA, to study the effect on DI application decisions of changes in the DI cash benefit amount, exploiting the fact that for individuals born after 1937, compared with older cohorts, DI benefits are more attractive than retirement benefits.[27] This quasi-experimental approach exploited an exogenous variation in benefits, and more accurately measures the cash benefit incentive of

[27] Our approach allows us to bypass the classical Lucas Critique (1976), which suggests that a new incentive structure would likely be linked with a new parameter set, making the prediction of the reduced form model inappropriate (e.g. Lahiri et al. 2008; Kreider and Riphahn, 2000).

applying to the DI program in the absence of Medicare incentives, often linked to the DI program that likely confounded earlier estimates of the application benefit elasticity.

We find a sizable effect of exogenous comparative increases in DI benefits on application decisions for those aged between 62 and the NRA. The elasticity estimate ranged between 0.86 and 1.02. This is in general larger than previous estimates. The sample used in previous studies pooled younger ages (<62) and older ages (>=62) together without modeling the different Social Security incentive structures faced at widely different ages. As we discussed earlier, if cash benefit incentives and Medicare incentives in the DI program are negatively correlated, studies that do not properly control for Medicare incentives would have underestimated the effect of cash benefits. It should also be taken into account, to understand the difference between our results and previous work, that we are using more recent and more detailed data than most previous studies, and the focus on older individuals to circumvent the empirical challenges in modeling Medicare preferences and provide a cleaner estimate of cash benefit effect, might have lead us to focus on a population who could be more responsive to the financial incentives, probably because they see DI as a kind of upgrade on their retirement benefits, and when pooled with younger individuals who just need something to get by after a serious challenge to their earnings capacity, the effects are less dramatic.

We can apply our estimates to help explain the doubling of applications to the DI program since the beginning of this century. Although many factors contributed to this surge of applications, from aging of the baby boomers into ages with high rates of disability, to increased female labor force participation, to an increase in the social acceptance of disability, to difficult labor market conditions of the last few years, our results suggest an increase of 22 percent to 26percent in applications for individuals 62 and older, due to a 25 percent increase in the financial appeal of disability benefits relative to retirement benefits for those whose retirement age changed from 65 to 66. This means that our estimates can explain at most 26 percent of the 100 percent-increase in applications for this age group in the 2000 to 2007, and about 16 percent of the increase in the 2000 to 2010 period. The results further suggest that, with the coming increase of the normal retirement age to age 67, the financial appeal of the disability program will increase. Furthermore, additional reforms to the Social Security system required to restore fiscal balance will provoke additional consideration of further increases in the NRA. Unless DI benefits or eligibilities are also adjusted, something rarely brought up in policy debates, growing interest in the DI program will continue.

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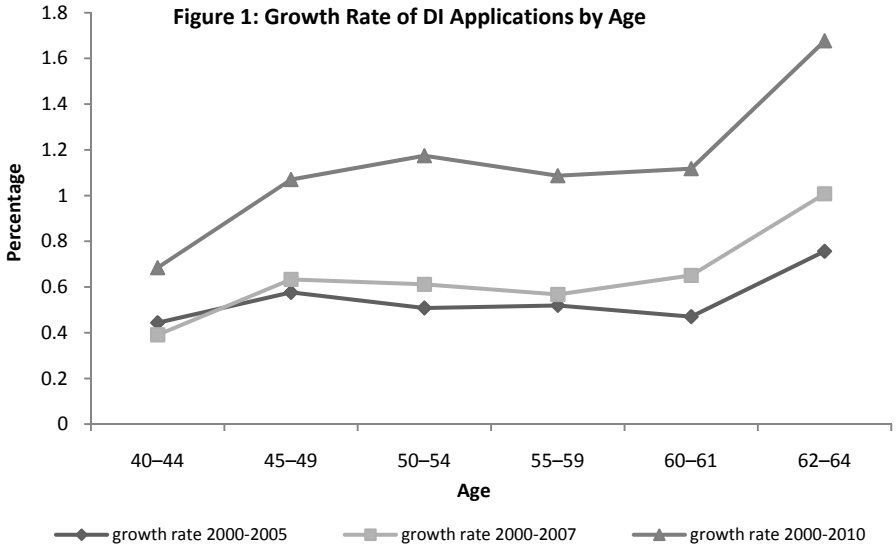

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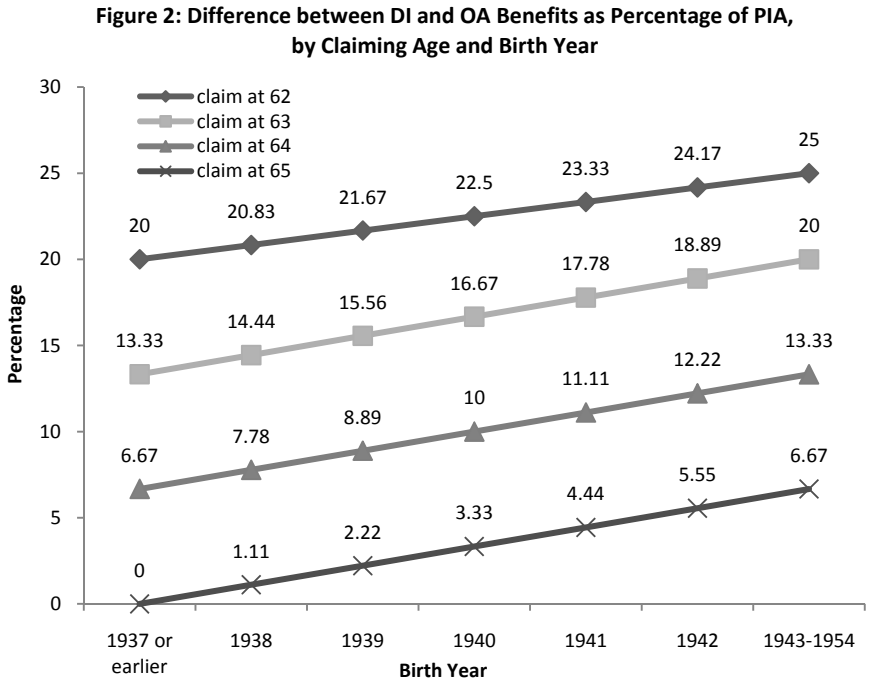

Note: The gain from receiving DI benefits is a bit smaller than shown in the Figure if the individual has already been receiving OA benefits before receiving DI benefits.

Table 1: Descriptive Statistics of Age 62-NRA. Cohorts Born <= 1937 vs. Cohorts Born >= 1938

	Cohorts Born 1931-37		Cohorts Born 1938-44		Mean diff.
	Mean	Std. Dev.	Mean	Std. Dev.	(younger-older cohorts)
Measure of Comparative Generosity of DI					
Apply for DI between period t-1 and t	0.011	0.102	0.020	0.142	0.010***
Indicator of Receiving OA Benefits					
Receiving OA benefits (at time t)	0.320	0.466	0.317	0.465	-0.003
Demographics					
Age	62.1	1.4	62.3	1.6	0.158***
Male	0.456	0.498	0.436	0.496	-0.020***
Non-white	0.168	0.374	0.170	0.376	0.002
Married	0.776	0.417	0.773	0.419	-0.003
Less than high school	0.242	0.428	0.187	0.390	-0.055***
High School	0.375	0.484	0.352	0.478	-0.023***
Some College	0.182	0.386	0.219	0.414	0.037***
College or more	0.202	0.401	0.242	0.428	0.040***
Health					
Health limits work	0.135	0.341	0.135	0.342	0.001
Fair/poor health	0.145	0.352	0.153	0.360	0.008
Health gets worse	0.120	0.325	0.177	0.382	0.057***
Health gets better	0.126	0.332	0.107	0.309	-0.019***
Number of ADLs	0.065	0.333	0.086	0.414	0.021***
Number of major health conditions	1.114	1.045	1.340	1.145	0.227***
Health Insurance (HI)					
Covered by HI from own work	0.528	0.499	0.554	0.497	0.027***
Covered by HI from spouse work	0.229	0.420	0.232	0.422	0.004
Covered by government HI	0.095	0.293	0.078	0.268	-0.017***
Covered by other HI	0.159	0.366	0.115	0.319	-0.044***
Covered by long-term care insurance	0.058	0.233	0.106	0.307	0.048***
Medical Care Utilization and Exp.					
Any hospital stay last year	0.126	0.332	0.154	0.361	0.028***
Any doctor visit last year	0.872	0.335	0.918	0.274	0.047***
Out-of-pocket medical expenditures	0.157	0.458	0.222	0.583	0.065***
Income and Wealth					
Income last year	2.884	4.094	3.042	7.005	0.158*
Other household income last year	5.198	10.146	6.405	17.420	1.207***
Net worth of non-housing wealth	12.607	52.257	17.275	132.264	4.668***
Employment					
Working for pay last wave	0.652	0.476	0.674	0.469	0.022***
Total number of years worked	32.86	13.43	33.96	12.31	1.104***
White collar	0.284	0.451	0.313	0.464	0.029***
Indicators of Residence Region					
South	0.411	0.492	0.407	0.491	-0.004
West	0.161	0.367	0.175	0.380	0.014**
Northeast	0.169	0.374	0.160	0.366	-0.009
Midwest	0.260	0.438	0.256	0.436	-0.004
Year Indicators					
1994-1995	0.230	0.421			
1996-1997	0.317	0.465			
1998-1999	0.269	0.444	0.028	0.164	
2000	0.153	0.360	0.141	0.349	
2002-2003	0.030	0.172	0.276	0.447	
2004-2005			0.288	0.453	
2006-2007			0.164	0.370	
2008-2009			0.088	0.283	
2010-2011			0.015	0.120	
Number of observations	*8919*		*8977*		

Note: All the variables are measured at time t-1 unless otherwise noted. ADLs refer to Activities of Daily Living. Major health conditions include 1) high blood pressure or hypertension; 2) diabetes or high blood sugar; 3) cancer or a malignant tumor or any kind except skin cancer; 4) chronic lung disease except asthma such as chronic bronchitis or emphysema; 5) heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems; 6) stroke or transient ischemic attack; 7) emotional, nervous, or psychiatric problems; and 8) arthritis or rheumatism. "Covered by Other HI" indicates coverage by any health insurance other than government, employer-provided (own or spouse employer), or long term care insurance. "Other household income" includes spouse earnings, household capital income, pension/annuity income, Social Security income, Unemployment Insurance, Workers Compensation income, income from other government transfers and all other household income. All dollar amounts are in $10,000 at 2009 level. The year indicators are consistent with the year in which each wave of interview was conducted. ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively.

Table 2: Descriptive Statistics of DI Applicants of Age 62-NRA. Cohorts Born <= 1937 vs. Cohorts Born >= 1938

	Cohorts Born 1931-37		Cohorts Born 1938-44		Mean diff.
	Mean	Std. Dev.	Mean	Std. Dev.	(younger-older cohorts)
Indicator of Receiving OA Benefits					
Receiving OA benefits (at time t)	0.170	0.378	0.196	0.398	0.025
Demographics					
Age	61.9	1.4	61.8	1.4	-0.073
Male	0.521	0.502	0.467	0.500	-0.054
Non-white	0.298	0.460	0.283	0.451	-0.015
Married	0.660	0.476	0.707	0.457	0.047
Less than high school	0.415	0.495	0.397	0.491	-0.018
High school	0.372	0.486	0.299	0.459	-0.073
Some college	0.128	0.335	0.207	0.406	0.079
College or more	0.085	0.281	0.098	0.298	0.013
Health					
Health limits work	0.372	0.486	0.418	0.495	0.046
Fair/poor health	0.479	0.502	0.451	0.499	-0.028
Health gets worse	0.436	0.499	0.370	0.484	-0.067
Health gets better	0.064	0.246	0.065	0.248	0.001
Number of ADLs	0.383	0.869	0.462	1.007	0.079
Number of major health conditions	1.840	1.176	2.147	1.308	0.306*
Health Insurance (HI)					
Covered by HI from own work	0.596	0.493	0.505	0.501	-0.090
Covered by HI from spouse work	0.096	0.296	0.250	0.434	0.154***
Covered by government HI	0.202	0.404	0.092	0.290	-0.110***
Covered by other HI	0.128	0.335	0.082	0.274	-0.046
Covered by long-term care insurance	0.096	0.296	0.054	0.227	-0.041
Medical Care Utilization and Exp.					
Any hospital stay last year	0.255	0.438	0.380	0.487	0.125**
Any doctor visit last year	0.872	0.335	0.962	0.192	0.090***
Out-of-pocket medical expenditures	0.159	0.328	0.317	0.723	0.158**
Income and Wealth					
Income last year	3.223	3.517	2.439	3.112	-0.784*
Other household income last year	2.466	3.338	4.336	12.461	1.869
Net worth of non-housing wealth	4.829	21.267	5.105	17.880	0.276
Employment					
Working for pay last wave	0.702	0.460	0.663	0.474	-0.039
Total number of years worked	33.00	13.03	34.72	12.53	1.723
White collar	0.106	0.310	0.158	0.365	0.051
Indicators of Residence Region					
South	0.468	0.502	0.446	0.498	-0.022
West	0.128	0.335	0.196	0.398	0.068
Northeast	0.202	0.404	0.120	0.325	-0.083*
Midwest	0.202	0.404	0.239	0.428	0.037
Year Indicators					
1994-1995	0.191	0.396			
1996-1997	0.181	0.387			
1998-1999	0.319	0.469	0.033	0.178	
2000	0.277	0.450	0.196	0.398	
2002-2003	0.032	0.177	0.370	0.484	
2004-2005			0.250	0.434	
2006-2007			0.098	0.298	
2008-2009			0.049	0.216	
2010-2011			0.005	0.074	
Number of observations	*94*		*184*		

Note: All the variables are measured at time t-1 unless otherwise noted. ADLs refer to Activities of Daily Living. Major health conditions include 1) high blood pressure or hypertension; 2) diabetes or high blood sugar; 3) cancer or a malignant tumor or any kind except skin cancer; 4) chronic lung disease except asthma such as chronic bronchitis or emphysema; 5) heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems; 6) stroke or transient ischemic attack; 7) emotional, nervous, or psychiatric problems; and 8) arthritis or rheumatism. "Covered by Other HI" indicates coverage by any health insurance other than government, employer-provided (own or spouse employer), or long term care insurance. "Other household income" includes spouse earnings, household capital income, pension/annuity income, Social Security income, Unemployment Insurance, Workers Compensation income, income from other government transfers and all other household income. All dollar amounts are in $10,000 at 2009 level. The year indicators are consistent with the year in which each wave of interview was conducted. ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively.

Table 3: Descriptive Statistics. Applicants vs. Non-applicants at age 62-NRA

	Applicants		Non-Applicants		Mean diff.
	Mean	Std. Dev.	Mean	Std. Dev.	(nonappl.-appl.)
Measure of Comparative Generosity of DI					
Cohort facing NRA 65	0.338	0.474	0.501	0.500	0.163***
Cohort facing NRA 65 and 2 months	0.097	0.297	0.072	0.259	-0.025
Cohort facing NRA 65 and 4 months	0.140	0.348	0.083	0.275	-0.058***
Cohort facing NRA 65 and 6 months	0.112	0.315	0.080	0.272	-0.031*
Cohort facing NRA 65 and 8 months	0.129	0.336	0.088	0.284	-0.041**
Cohort facing NRA 65 and 10 months	0.083	0.276	0.065	0.246	-0.018
Cohort facing NRA 66	0.101	0.301	0.111	0.314	0.010
Indicator of Receiving OA Benefits					
Receiving OA benefits (at time t)	0.187	0.391	0.321	0.467	0.134***
Demographics					
Age	61.8	1.4	62.2	1.5	0.355***
Male	0.486	0.501	0.446	0.497	-0.040
Non-white	0.288	0.454	0.167	0.373	-0.120***
Married	0.691	0.463	0.776	0.417	0.085***
Less than high school	0.403	0.491	0.211	0.408	-0.192***
High school	0.324	0.469	0.364	0.481	0.040
Some college	0.180	0.385	0.201	0.401	0.021
College or more	0.094	0.292	0.224	0.417	0.130***
Health					
Health limits work	0.403	0.491	0.131	0.337	-0.272***
Fair/poor health	0.460	0.499	0.144	0.351	-0.317***
Health gets worse	0.392	0.489	0.145	0.352	-0.247***
Health gets better	0.065	0.247	0.117	0.322	0.053***
Number of ADLs	0.435	0.962	0.070	0.356	-0.365***
Number of major health conditions	2.043	1.271	1.214	1.094	-0.829***
Health Insurance (HI)					
Covered by HI from own work	0.536	0.500	0.541	0.498	0.005
Covered by HI from spouse work	0.198	0.399	0.231	0.421	0.033
Covered by government HI	0.129	0.336	0.086	0.280	-0.044***
Covered by other HI	0.097	0.297	0.138	0.344	0.040*
Covered by long-term care insurance	0.068	0.253	0.082	0.274	0.014
Medical Care Utilization and Exp.					
Any hospital stay last year	0.338	0.474	0.137	0.344	-0.201***
Any doctor visit last year	0.932	0.253	0.894	0.307	-0.037**
Out-of-pocket medical expenditures	0.264	0.622	0.188	0.524	-0.075**
Income and Wealth					
Income last year	2.704	3.270	2.968	5.772	0.264
Other household income last year	3.704	10.349	5.836	14.329	2.133**
Net worth of non-housing wealth	5.012	19.055	15.106	101.458	10.094*
Employment	0.000	0.000	0.000	0.000	0.000
Working for pay last wave	0.676	0.469	0.663	0.473	-0.013
Total number of years worked	34.14	12.70	33.40	12.89	-0.74
White collar	0.140	0.348	0.301	0.459	0.161***
Indicators of Residence Region					
South	0.453	0.499	0.409	0.492	-0.045
West	0.173	0.379	0.168	0.374	-0.005
Northeast	0.147	0.355	0.164	0.371	0.017
Midwest	0.227	0.419	0.258	0.438	0.031
Number of observations	278		17618		

Note: All the variables are measured at time t-1 unless otherwise noted. ADLs refer to Activities of Daily Living. Major health conditions include 1) high blood pressure or hypertension; 2) diabetes or high blood sugar; 3) cancer or a malignant tumor or any kind except skin cancer; 4) chronic lung disease except asthma such as chronic bronchitis or emphysema; 5) heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems; 6) stroke or transient ischemic attack; 7) emotional, nervous, or psychiatric problems; and 8) arthritis or rheumatism. "Covered by Other HI" indicates coverage by any health insurance other than government, employer-provided (own or spouse employer), or long term care insurance. "Other household income" includes spouse earnings, household capital income, pension/annuity income, Social Security income, Unemployment Insurance, Workers Compensation income, income from other government transfers and all other household income. All dollar amounts are in $10,000 at 2009 level. ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively.

Table 4: Descriptive Statistics of Age 51-58. Cohorts Born <= 1937 vs. Cohorts Born >= 1938

	Cohorts Born 1931-37		Cohorts Born 1938-44		Mean diff.
	Mean	Std. Dev.	Mean	Std. Dev.	(younger-older cohorts)
Measure of Comparative Generosity of DI					
Apply for DI between period t-1 and t	0.012	0.108	0.012	0.109	0.000
Demographics					
Age	57.324	0.736	55.326	1.962	-1.998***
Male	0.471	0.499	0.387	0.487	-0.084***
Non-white	0.168	0.374	0.173	0.378	0.005
Married	0.813	0.390	0.826	0.379	0.013
Less than high school	0.233	0.423	0.198	0.398	-0.035***
High school	0.381	0.486	0.364	0.481	-0.017
Some college	0.180	0.384	0.225	0.417	0.045***
College or more	0.206	0.405	0.214	0.410	0.008
Health					
Health limits work	0.111	0.314	0.108	0.310	-0.003
Fair/poor health	0.124	0.329	0.120	0.324	-0.004
Health gets worse	0.075	0.264	0.115	0.319	0.039***
Health gets better	0.139	0.346	0.129	0.335	-0.010
Number of ADLs	0.072	0.387	0.059	0.340	-0.013
Number of major health conditions	0.863	0.959	0.859	0.961	-0.004
Health Insurance (HI)					
Covered by HI from own work	0.552	0.497	0.529	0.499	-0.023*
Covered by HI from spouse work	0.273	0.446	0.301	0.459	0.028**
Covered by government HI	0.072	0.259	0.057	0.232	-0.015**
Covered by other HI	0.129	0.335	0.112	0.315	-0.017**
Covered by long-term care insurance	0.011	0.105	0.041	0.198	0.030***
Medical Care Utilization and Exp.					
Any hospital stay last year	0.086	0.280	0.103	0.304	0.017**
Any doctor visit last year	0.776	0.417	0.859	0.348	0.083***
Out-of-pocket medical expenditures	0.115	0.348	0.132	0.372	0.018*
Income and Wealth					
Income last year	4.025	7.046	3.689	4.998	-0.336**
Other household income last year	4.791	9.320	5.826	10.858	1.035***
Net worth of non-housing wealth	9.422	27.159	8.602	29.499	-0.819
Employment					
Working for pay last wave	0.770	0.421	0.797	0.402	0.027**
Total number of years worked	29.264	12.291	28.190	11.228	-1.075***
White collar	0.276	0.447	0.298	0.457	0.022*
Indicators of Residence Region					
South	0.406	0.491	0.406	0.491	0.000
West	0.168	0.374	0.170	0.376	0.002
Northeast	0.180	0.384	0.169	0.375	-0.011
Midwest	0.246	0.431	0.254	0.435	0.008
Year Indicators					
1994-1995	0.873	0.333	0.327	0.469	
1996-1997	0.127	0.333	0.331	0.471	
1998-1999			0.206	0.405	
2000			0.086	0.281	
2002-2003			0.049	0.216	
Number of observations	*1789*		*9495*		

Note: All the variables are measured at time t-1 unless otherwise noted. ADLs refer to Activities of Daily Living. Major health conditions include 1) high blood pressure or hypertension; 2) diabetes or high blood sugar; 3) cancer or a malignant tumor or any kind except skin cancer; 4) chronic lung disease except asthma such as chronic bronchitis or emphysema; 5) heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems; 6) stroke or transient ischemic attack; 7) emotional, nervous, or psychiatric problems; and 8) arthritis or rheumatism. "Covered by Other HI" indicates coverage by any health insurance other than government, employer-provided (own or spouse employer), or long term care insurance. "Other household income" includes spouse earnings, household capital income, pension/annuity income, Social Security income, Unemployment Insurance, Workers Compensation income, income from other government transfers and all other household income. All dollar amounts are in $10,000 at 2009 level. The year indicators are consistent with the year in which each wave of interview was conducted. ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively.

Table 5: Descriptive Statistics of DI Applicants of Age 51-58. Cohorts Born <= 1937 vs. Cohorts Born >= 1938

	Cohorts Born 1931-37		Cohorts Born 1938-44		Mean diff.
	Mean	Std. Dev.	Mean	Std. Dev.	(younger-older cohorts)
Demographics					
Age	57.1	0.8	55.7	1.9	-1.415***
Male	0.476	0.512	0.325	0.470	-0.152
Non-white	0.095	0.301	0.307	0.463	0.212**
Married	0.810	0.402	0.763	0.427	-0.046
Less than high school	0.476	0.512	0.360	0.482	-0.117
High school	0.429	0.507	0.412	0.494	-0.016
Some college	0.095	0.301	0.114	0.319	0.019
College or more	0.000	0.000	0.114	0.319	0.114
Health					
Health limits work	0.571	0.507	0.544	0.500	-0.028
Fair/poor health	0.524	0.512	0.500	0.502	-0.024
Health gets worse	0.286	0.463	0.368	0.485	0.083
Health gets better	0.286	0.463	0.140	0.349	-0.145*
Number of ADLs	0.524	0.928	0.605	1.094	0.081
Number of major health conditions	1.048	0.973	1.965	1.323	0.917***
Health Insurance (HI)					
Covered by HI from own work	0.381	0.498	0.360	0.482	-0.021
Covered by HI from spouse work	0.381	0.498	0.307	0.463	-0.074
Covered by government HI	0.143	0.359	0.088	0.284	-0.055
Covered by other HI	0.095	0.301	0.105	0.308	0.010
Covered by long-term care insurance	0.048	0.218	0.088	0.284	0.040
Medical Care Utilization and Exp.					
Any hospital stay last year	0.048	0.218	0.316	0.467	0.268**
Any doctor visit last year	0.905	0.301	0.956	0.206	0.051
Out-of-pocket medical expenditures	0.085	0.107	0.204	0.347	0.118
Income and Wealth					
Income last year	2.780	2.914	1.925	2.392	-0.855
Other household income last year	6.553	8.145	3.365	4.506	-3.188**
Net worth of non-housing wealth	2.586	5.293	4.876	27.831	2.290
Employment					
Working for pay last wave	0.476	0.512	0.596	0.493	0.120
Total number of years worked	28.33	12.00	28.84	10.14	0.509
White collar	0.190	0.402	0.175	0.382	-0.015
Indicators of Residence Region					
South	0.429	0.507	0.491	0.502	0.063
West	0.190	0.402	0.167	0.374	-0.024
Northeast	0.095	0.301	0.167	0.374	0.071
Midwest	0.286	0.463	0.175	0.382	-0.110
Year Indicators					
1994-1995	0.952	0.218	0.281	0.451	
1996-1997	0.048	0.218	0.246	0.432	
1998-1999			0.211	0.409	
2000			0.158	0.366	
2002-2003			0.105	0.308	
Number of observations	*21*		*114*		

Note: All the variables are measured at time t-1 unless otherwise noted. ADLs refer to Activities of Daily Living. Major health conditions include 1) high blood pressure or hypertension; 2) diabetes or high blood sugar; 3) cancer or a malignant tumor or any kind except skin cancer; 4) chronic lung disease except asthma such as chronic bronchitis or emphysema; 5) heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems; 6) stroke or transient ischemic attack; 7) emotional, nervous, or psychiatric problems; and 8) arthritis or rheumatism. "Covered by Other HI" indicates coverage by any health insurance other than government, employer-provided (own or spouse employer), or long term care insurance. "Other household income" includes spouse earnings, household capital income, pension/annuity income, Social Security income, Unemployment Insurance, Workers Compensation income, income from other government transfers and all other household income. All dollar amounts are in $10,000 at 2009 level. The year indicators are consistent with the year in which each wave of interview was conducted. ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively.

Table 6: Descriptive Statistics. Applicants vs. Non-applicants at age 51-58

	Applicants		Non-Applicants		Mean diff.
	Mean	Std. Dev.	Mean	Std. Dev.	(nonappl.-appl.)
Measure of Comparative Generosity of DI					
Cohort facing NRA 65	0.156	0.364	0.159	0.365	0.003
Cohort facing NRA 65 and 2 months	0.089	0.286	0.112	0.315	0.023
Cohort facing NRA 65 and 4 months	0.119	0.324	0.139	0.346	0.020
Cohort facing NRA 65 and 6 months	0.141	0.349	0.168	0.374	0.027
Cohort facing NRA 65 and 8 months	0.237	0.427	0.201	0.401	-0.036
Cohort facing NRA 65 and 10 months	0.089	0.286	0.089	0.284	0.000
Cohort facing NRA 66	0.170	0.377	0.133	0.340	-0.037
Demographics					
Age	55.9	1.8	55.6	2.0	-0.309*
Male	0.348	0.478	0.401	0.490	0.052
Non-white	0.274	0.448	0.171	0.376	-0.103***
Married	0.770	0.422	0.825	0.380	0.055*
Less than high school	0.378	0.487	0.201	0.401	-0.176***
High school	0.415	0.495	0.366	0.482	-0.049
Some college	0.111	0.315	0.219	0.414	0.108***
College or more	0.096	0.296	0.214	0.410	0.118***
Health					
Health limits work	0.548	0.500	0.103	0.304	-0.445***
Fair/poor health	0.504	0.502	0.116	0.320	-0.388***
Health gets worse	0.356	0.480	0.106	0.307	-0.250***
Health gets better	0.163	0.371	0.130	0.336	-0.033
Number of ADLs	0.593	1.067	0.055	0.324	-0.538***
Number of major health conditions	1.822	1.315	0.848	0.950	-0.974***
Health Insurance (HI)					
Covered by HI from own work	0.363	0.483	0.535	0.499	0.172***
Covered by HI from spouse work	0.319	0.468	0.297	0.457	-0.022
Covered by government HI	0.096	0.296	0.059	0.236	-0.037*
Covered by other HI	0.104	0.306	0.115	0.319	0.011
Covered by long-term care insurance	0.081	0.275	0.036	0.186	-0.046***
Medical Care Utilization and Exp.					
Any hospital stay last year	0.274	0.448	0.098	0.297	-0.176***
Any doctor visit last year	0.948	0.223	0.845	0.362	-0.103***
Out-of-pocket medical expenditures	0.185	0.324	0.129	0.369	-0.056*
Income and Wealth					
Income last year	2.058	2.487	3.762	5.399	1.704***
Other household income last year	3.861	5.326	5.684	10.682	1.823**
Net worth of non-housing wealth	4.520	25.652	8.783	29.178	4.263*
Employment					
Working for pay last wave	0.578	0.496	0.795	0.403	0.218***
Total number of years worked	28.76	10.40	28.36	11.42	-0.408
White collar	0.178	0.384	0.296	0.456	0.118***
Indicators of Residence Region					
South	0.481	0.502	0.405	0.491	-0.076*
West	0.170	0.377	0.170	0.376	0.000
Northeast	0.156	0.364	0.171	0.376	0.015
Midwest	0.193	0.396	0.254	0.435	0.061
Number of observations	135		11149		

Note: All the variables are measured at time t-1 unless otherwise noted. ADLs refer to Activities of Daily Living. Major health conditions include 1) high blood pressure or hypertension; 2) diabetes or high blood sugar; 3) cancer or a malignant tumor or any kind except skin cancer; 4) chronic lung disease except asthma such as chronic bronchitis or emphysema; 5) heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems; 6) stroke or transient ischemic attack; 7) emotional, nervous, or psychiatric problems; and 8) arthritis or rheumatism. "Covered by Other HI" indicates coverage by any health insurance other than government, employer-provided (own or spouse employer), or long term care insurance. "Other household income" includes spouse earnings, household capital income, pension/annuity income, Social Security income, Unemployment Insurance, Workers Compensation income, income from other government transfers and all other household income. All dollar amounts are in $10,000 at 2009 level. ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively.

Table 7: Estimation of DI Applications for Individuals of Age 62-NRA. (Average Marginal Effects)

	Pooled Probit			w/t Heckman Correct.			Recursive Bivariate Probit			SUR Bivariate Probit		
Comparative Generosity of DI												
NRA category	0.0011	(0.0004)	***	0.0012	(0.0004)	***	0.0010	(0.0004)	**	0.0011	(0.0004)	***
Indicator of Receiving OA Benefits												
Receiving OA benefits	-0.0119	(0.0028)	***	-0.0117	(0.0032)	***	-0.0321	(0.0080)	***	n/a		
Demographics												
Age	-0.0013	(0.0007)	**	-0.0009	(0.0007)		0.0016	(0.0012)		-0.0029	(0.0006)	***
Male	0.0023	(0.0022)		0.0018	(0.0026)		0.0020	(0.0025)		0.0024	(0.0022)	
Non-white	0.0057	(0.0022)	**	0.0063	(0.0025)	**	0.0059	(0.0025)	**	0.0060	(0.0022)	***
Married	-0.0045	(0.0023)	*	-0.0050	(0.0026)	*	-0.0059	(0.0027)	**	-0.0038	(0.0022)	*
Less than high school	0.0071	(0.0024)	***	0.0081	(0.0027)	***	0.0081	(0.0026)	***	0.0071	(0.0022)	***
Some college	-0.0006	(0.0026)		-0.0008	(0.0030)		-0.0007	(0.0029)		-0.0004	(0.0026)	
College or more	-0.0046	(0.0032)		-0.0047	(0.0037)		-0.0065	(0.0037)	*	-0.0039	(0.0031)	
Health												
Health limits work	0.0118	(0.0024)	***	0.0116	(0.0028)	***	0.0137	(0.0029)	***	0.0117	(0.0024)	***
Fair/poor health	0.0072	(0.0025)	***	0.0080	(0.0028)	***	0.0077	(0.0028)	***	0.0073	(0.0025)	***
Health gets worse	0.0045	(0.0024)	*	0.0046	(0.0027)	*	0.0053	(0.0027)	*	0.0045	(0.0024)	*
Health gets better	-0.0062	(0.0034)	*	-0.0077	(0.0039)	*	-0.0072	(0.0039)	*	-0.0064	(0.0034)	*
Number of ADLs	0.0061	(0.0014)	***	0.0074	(0.0017)	***	0.0069	(0.0017)	***	0.0061	(0.0014)	***
Number of major health conditions	0.0043	(0.0008)	***	0.0048	(0.0010)	***	0.0050	(0.0010)	***	0.0042	(0.0008)	***
Health Insurance (HI)												
Covered by HI from own work	0.0014	(0.0025)		0.0006	(0.0029)		0.0006	(0.0028)		0.0021	(0.0024)	
Covered by HI from spouse work	0.0028	(0.0029)		0.0027	(0.0033)		0.0031	(0.0033)		0.0030	(0.0028)	
Covered by government HI	-0.0008	(0.0033)		-0.0006	(0.0036)		-0.0001	(0.0038)		-0.0011	(0.0033)	
Covered by other HI	-0.0010	(0.0031)		-0.0031	(0.0036)		-0.0008	(0.0035)		-0.0012	(0.0031)	
Covered by long-term care insurance	0.0006	(0.0034)		0.0012	(0.0039)		0.0010	(0.0039)		0.0005	(0.0034)	
Medical Care Utilization and Exp.												
Any hospital stay last year	0.0079	(0.0021)	***	0.0090	(0.0024)	***	0.0091	(0.0025)	***	0.0078	(0.0021)	***
Any doctor visit last year	0.0013	(0.0035)		0.0009	(0.0041)		0.0018	(0.0040)		0.0014	(0.0034)	
Out-of-pocket medical expenditures	0.0003	(0.0013)		0.0002	(0.0014)		0.0003	(0.0015)		0.0003	(0.0013)	
Income and Wealth												
Income last year	0.0002	(0.0002)		0.0006	(0.0003)	*	0.0000	(0.0003)		0.0002	(0.0001)	
Other household income last year	0.0000	(0.0001)		0.0000	(0.0001)		0.0000	(0.0002)		0.0000	(0.0001)	
Net worth of non-housing wealth	-0.0001	(0.0000)		-0.0001	(0.0001)		-0.0001	(0.0001)		-0.0001	(0.0000)	
Employment												
Working for pay last wave	0.0038	(0.0024)		0.0053	(0.0027)	*	0.0005	(0.0031)		0.0060	(0.0025)	**
Total number of years worked	0.0002	(0.0001)	**	0.0002	(0.0001)	**	0.0003	(0.0001)	***	0.0002	(0.0001)	*
White collar	-0.0074	(0.0026)	***	-0.0075	(0.0030)	**	-0.0089	(0.0030)	***	-0.0070	(0.0025)	***
Indicators of Residence Region												
South	0.0020	(0.0024)		0.0020	(0.0028)		0.0023	(0.0026)		0.0020	(0.0023)	
West	0.0029	(0.0030)		0.0037	(0.0034)		0.0024	(0.0033)		0.0033	(0.0029)	
Northeast	0.0005	(0.0030)		0.0000	(0.0035)		0.0004	(0.0033)		0.0006	(0.0029)	
Excluded variable in DI equation												
Plan to work after age 62							0.0002	(0.0030)		0.0002	(0.0026)	
arthro				-0.2755	(0.1595)	*	0.2868	(0.0868)	***	-0.1529	(0.0452)	***
rho				-0.2687	(0.1480)		0.2792	(0.0800)		-0.1517	(0.0441)	
Wald Test of rho=0					2.980	*		10.918	***		11.461	***
Number of observations	17896											
Log pseudolikelihood	-1219.3			-2557.4			-8550.0			-8555.2		

Note: Standard errors are shown in parenthesis and are adjusted for clusters in individuals. ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively.

Table 8: Estimation of DI Applications for Individuals of Age 51-58. (Average Marginal Effects)

	Pooled Probit			w/t Heckman Correct.		
Comparative Generosity of DI						
NRA category	0.0009	(0.0006)		0.0010	(0.0007)	
Demographics						
Age	0.0004	(0.0005)		0.0005	(0.0006)	
Male	0.0005	(0.0025)		0.0001	(0.0030)	
Non-white	0.0041	(0.0024)	*	0.0047	(0.0029)	*
Married	-0.0014	(0.0029)		-0.0016	(0.0034)	
Less than high school	0.0023	(0.0025)		0.0028	(0.0029)	
Some college	-0.0094	(0.0032)	***	-0.0107	(0.0038)	***
College or more	-0.0072	(0.0035)	**	-0.0080	(0.0041)	**
Health						
Health limits work	0.0144	(0.0025)	***	0.0158	(0.0034)	***
Fair/poor health	0.0064	(0.0027)	**	0.0074	(0.0031)	**
Health gets worse	0.0044	(0.0027)		0.0052	(0.0032)	*
Health gets better	0.0038	(0.0028)		0.0046	(0.0032)	
Number ADLs	0.0056	(0.0014)	***	0.0065	(0.0017)	***
Number major health conditions	0.0024	(0.0010)	**	0.0027	(0.0011)	**
Health Insurance (HI)						
Covered by HI from own work	-0.0053	(0.0027)	**	-0.0065	(0.0032)	**
Covered by HI from spouse work	-0.0003	(0.0028)		-0.0002	(0.0032)	
Covered by government HI	-0.0049	(0.0046)		-0.0051	(0.0055)	
Covered by other HI	-0.0018	(0.0031)		-0.0020	(0.0036)	
Covered by long-term care ins.	0.0107	(0.0041)	***	0.0127	(0.0048)	***
Medical Care Utilization and Exp.						
Any hospital stay last year	0.0053	(0.0026)	**	0.0060	(0.0030)	**
Any doctor visit last year	0.0070	(0.0040)	*	0.0083	(0.0046)	*
Out-of-pocket medical expenses	-0.0003	(0.0018)		-0.0005	(0.0020)	
Income and Wealth						
Income last year	-0.0003	(0.0004)		-0.0001	(0.0006)	
Other household income last year	-0.0003	(0.0002)		-0.0003	(0.0003)	
Net worth of non-housing wealth	0.0000	(0.0001)		0.0000	(0.0001)	
Employment						
Working for pay last wave	-0.0024	(0.0026)		-0.0025	(0.0030)	
Total number of years worked	0.0004	(0.0001)	***	0.0004	(0.0001)	***
White collar	0.0004	(0.0027)		0.0002	(0.0031)	
Indicators of Residence Region						
South	0.0027	(0.0026)		0.0030	(0.0031)	
West	0.0007	(0.0033)		0.0012	(0.0038)	
Northeast	0.0018	(0.0032)		0.0019	(0.0037)	
athrho				-0.2020	(0.3167)	
rho				-0.1993	(0.3041)	
Wald Test of rho=0					0.410	
Number of observations	11284					
Log pseudolikelihood	-576.7			-1126.5		

Note: Standard errors are shown in parenthesis and are adjusted for clusters in individuals. ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively.

Table 9: Pooled Probit Estimation of DI Applications up to year 2007. (Average Marginal Effects)

	Age 62-NRA			Age 51-58		
Comparative Generosity of DI						
NRA category	0.0011	(0.0004)	***	0.0009	(0.0006)	
Indicator of Receiving OA Benefits						
Receiving OA benefits	-0.0119	(0.0028)	***	n/a		
Demographics						
Age	-0.0012	(0.0007)	*	0.0004	(0.0005)	
Male	0.0025	(0.0022)		0.0005	(0.0025)	
Non-white	0.0056	(0.0022)	**	0.0041	(0.0024)	*
Married	-0.0045	(0.0023)	*	-0.0014	(0.0029)	
Less than high school	0.0070	(0.0024)	***	0.0023	(0.0025)	
Some college	-0.0006	(0.0026)		-0.0094	(0.0032)	***
College or more	-0.0046	(0.0033)		-0.0072	(0.0035)	**
Health						
Health limits work	0.0118	(0.0024)	***	0.0144	(0.0025)	***
Fair/poor health	0.0072	(0.0025)	***	0.0064	(0.0027)	**
Health gets worse	0.0045	(0.0024)	*	0.0044	(0.0027)	
Health gets better	-0.0062	(0.0034)	*	0.0038	(0.0028)	
Number of ADLs	0.0061	(0.0015)	***	0.0056	(0.0014)	***
Number of major health conditions	0.0043	(0.0009)	***	0.0024	(0.0010)	**
Health Insurance (HI)						
Covered by HI from own work	0.0014	(0.0025)		-0.0053	(0.0027)	**
Covered by HI from spouse work	0.0028	(0.0029)		-0.0003	(0.0028)	
Covered by government HI	-0.0006	(0.0034)		-0.0049	(0.0046)	
Covered by other HI	-0.0010	(0.0031)		-0.0018	(0.0031)	
Covered by long-term care insurance	0.0006	(0.0035)		0.0107	(0.0041)	***
Medical Care Utilization and Exp.						
Any hospital stay last year	0.0078	(0.0021)	***	0.0053	(0.0026)	**
Any doctor visit last year	0.0013	(0.0035)		0.0070	(0.0040)	*
Out-of-pocket medical expenditures	0.0003	(0.0013)		-0.0003	(0.0018)	
Income and Wealth						
Income last year	0.0002	(0.0002)		-0.0003	(0.0004)	
Other household income last year	0.0000	(0.0001)		-0.0003	(0.0002)	
Net worth of non-housing wealth	-0.0001	(0.0000)		0.0000	(0.0001)	
Employment						
Working for pay last wave	0.0037	(0.0025)		-0.0024	(0.0026)	
Total number of years worked	0.0002	(0.0001)	**	0.0004	(0.0001)	***
White collar	-0.0074	(0.0026)	***	0.0004	(0.0027)	
Indicators of Residence Region						
South	0.0020	(0.0024)		0.0027	(0.0026)	
West	0.0028	(0.0030)		0.0007	(0.0033)	
Northeast	0.0005	(0.0030)		0.0018	(0.0032)	
Number of observations	17764			11284		
Pseudo R-squared	0.148			0.212		
Log pseudolikelihood	-1216.0			-576.72		

Note: Standard errors are shown in parenthesis and are adjusted for clusters in individuals. ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively.