

**Economic Research Initiative on the Uninsured
Working Paper Series**

**THE VALUE OF THE MEDICARE BENEFIT FOR SOCIAL
SECURITY DISABILITY INSURANCE RECIPIENTS**

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ERIU Working Paper 10
www.umich.edu/~eriu/pdf/wp10.pdf

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July 2, 2002

Acknowledgements: Financial support was provided through a grant from the University of Michigan's Economic Research Initiative on the Uninsured, funded by the Robert Wood Johnson Foundation. We thank Kalman Rupp, John Bound, and Timothy Waidmann for helpful comments. We are grateful to Chris Horn for able research assistance.

ABSTRACT

Access to Medicare is a valuable benefit for those on the Social Security Disability Insurance (DI) program. Previous research has shown that access to health insurance is a major determinant of labor force decisions such as retirement or job change, yet no study has empirically evaluated the value of the Medicare benefit for DI recipients. In this paper, we do so using data from the Medicare Current Beneficiary Survey and the Health and Retirement Survey. We estimate the distribution of Medicare spending for DI beneficiaries, and their distribution of out-of-pocket costs for health care. We find that lifetime Medicare benefits are substantial and vary widely with the main cause of enrollment in the DI program. The relationship between lifetime benefits and initial age of reciprocity follow an inverted “U” shape, peaking between age 30 and 35 for most diagnoses and at reasonable rates of time discounting. DI recipients with mental illness consume the most in Medicare benefits over their lifetime—roughly \$75,000 in lifetime benefits in net present value terms for those who start receiving DI benefits at age 30 (and assuming a 5% discount rate).

1.0 INTRODUCTION

One of the core provisions of the Social Security Disability Insurance (DI) program is that participants are eligible for Medicare. Previous research has shown that access to health insurance is a major determinant of labor force decisions such as whether to retire or change jobs, especially among people in poor health. Uninsured people with limited access to affordable health insurance may thus have a relatively strong incentive to apply for DI. Similarly, DI participants who might otherwise exit the program may choose to continue in order to preserve their Medicare coverage. These incentives affect the fiscal viability of Medicare and may increase burdens on federal taxpayers.

Perhaps surprisingly, however, no research has evaluated the value of Medicare participation for DI beneficiaries, nor whether and how DI's Medicare-eligibility provision affects individuals' decisions to apply for or exit DI. This paper fills this gap, by assessing the value of Medicare for DI beneficiaries. In particular, we are interested in understanding the Medicare expenditures of DI beneficiaries with different diagnoses.

In 1997, the average annual DI benefit was around \$8,700. By comparison, annual Medicare reimbursements per DI recipient were nearly \$5,000, more than half the value of the average cash benefit (Social Security Bulletin, 1998). Moreover, for people in the DI population – who by definition have major health problems – private non-group health insurance coverage is likely to cost considerably more than \$5,000 per year. As a result, DI is likely to be particularly appealing to individuals without access to other sources of group health insurance, such as coverage through an employer-sponsored retiree plan, a spouse, or Medicaid.

Indeed, DI applicants state that Medicare eligibility is important to them; and research has shown that older workers in poor health with access to private, post-retirement health

insurance are much more likely to leave the workforce prior to age 65 (the normal age of Medicare eligibility) than similar workers with no such access. At the same time, policies such as the 1999 Work Incentives Improvement Act, which extends the period of Medicare eligibility after DI exit from four to six years, suggests that policymakers believe Medicare eligible to be an important factor affecting DI participation.

With some 4.5 million participants in the DI program (representing 12 percent of Medicare enrollees), improved understanding the value of Medicare to DI participants is clearly important in its own right. Estimating the value of Medicare for DI recipients with different diagnoses is important because this information can be used by program managers to better understand the needs of their clients.

2.0 THEORETICAL FRAMEWORK

In this paper, we do our best to measure the mortality and time discounted sum until age 65 of per-person average Medicare expenditures by DI recipients. Though this figure should clearly interest policy makers interested in the fiscal effects of the Medicare portion of the DI program, it is less clear why this figure should be of general interest. In particular, it is difficult to tell from this figure alone whether Medicare expenditures by DI recipients are too low, too high, or just right. The question that we address in this section is under what conditions does our measure of lifetime expenditures on Medicare reflect the true marginal value of Medicare to DI recipients? Our strategy is to lay out three critical conditions that must be met for this quantity to correctly reflect the value of the Medicare benefit, and then to discuss how violations of those conditions make our measure an over- or under-estimate of the true value of the benefit.

2.1 *Conditions for Optimal DI expenditures*

The basic actor in our framework is an individual who at time zero does not know whether or when he will suffer a shock that will disable him. Each period, he can spend his given stream of income (which is forthcoming unless the person becomes disabled) on disability insurance or on private goods such as health insurance. If or when this individual is determined to be disabled, disability insurance will pay out a stream of income each period starting after the determination of disability. In addition, it will furnish the disability insurance recipient with health insurance—Medicare—free of charge. There is a government sector whose sole activities are to collect taxes and provide disability insurance and Medicare for DI recipients.

In this framework, after a disabled person has enrolled on DI, the Medicare benefit is a transfer payment that some may value more than others. Indeed, in the next section, we discuss in detail which people are most likely to benefit from Medicare transfers. Broadly viewed, however, the Medicare benefit is not really a transfer at all, but rather one payout from an insurance program designed to reduce the financial and medical impact of becoming disabled.

That DI is a government program, and not a private one, does not alter what is necessary to make expenditures on DI optimal relative to expenditures on all other goods: the expected marginal utility of expenditures on disability insurance equals the marginal utility of expenditures on private goods. Of course, these optimality conditions are from an *ex ante* point of view (before the revelation of whether someone is disabled). Also, since our framework involves decisions made over time, marginal utility in these conditions really means the net present value of the stream of marginal utility.

That DI is not purchased on a private market relieves us of some analytic difficulties, while introducing others. In particular, since everyone (at the same income level and facing the

same marginal tax rate) is required to “purchase” the same amount of disability insurance through tax payments, there are no thorny adverse selection issues to consider with respect to the purchase of DI. At the same time, there is no reason for the government to pick expenditures of disability insurance optimally even in an average sense. We explore the consequences of this observation shortly. On the other hand, to avoid issues related to non-actuarially fair “pricing” of disability insurance, we require a balanced DI budget—expenditures on DI recipients are matched exactly by lifetime taxes. We are now ready to state our first condition.

Condition 1: The net present value of marginal utility of private expenditures equals the expected net present value of marginal utility of expenditures by the disability insurance on the disabled.

Up to now, we have treated DI expenditures monolithically. However, for our purposes it is important to recognize that DI benefits come in two separate forms—pure cash payouts that can be spent on private goods, and a “voucher” that can only be “spent” on Medicare.

Optimality requires that the amount put into the cash transfer is in the right balance with the amount put into Medicare. To be optimal, the distribution of funds to DI recipients between Medicare and cash payouts must (at least¹) be set such in the disabled state, the marginal utility from Medicare expenditures, measured from the point of disability, equal the marginal utility on private goods purchased with the DI cash payments, also measured from the point of disability.

Condition 2: In the disabled state, the expected net present value of marginal utility of expenditures on Medicare from the point of disability must equal the expected net present value of marginal utility of cash payouts by the program also from the point of disability.

The key difficulty in implementing this condition relates to information problems in the market for health insurance, on which the value of marginal utility of expenditures on Medicare depends. Information problems in the market for health insurance are also related to why DI

¹ We stress that these conditions are necessary, not sufficient for optimality.

benefits are divided up in this way to begin with. Private insurers can certainly observe that DI recipients are disabled and hence likely to spend more than their non-disabled counterparts. If this *observable* classification risk were the end of the story, under competitive conditions premiums charged to the disabled would adequately reflect the risk of medical expenditures and there would be no inherent difficulty with the private provision of health insurance to the disabled. In this circumstance, there would be no reason to divide up DI payments into cash payouts and a Medicare voucher, which risks putting too much money into medical care. Instead, it would be better to have the entire DI payment be a cash payout, and let the disabled applicant work out how much to spend on private medical care insurance after the fact.

However, the disabled are likely to be heterogeneous in their risk of medical expenditures in ways that are not observable by private insurance companies or by the government. If this *unobservable* heterogeneity is important enough, at the extreme it would make it difficult to sustain a private market in health insurance for the disabled, and the alternative to government financed Medicare would be no health insurance at all. Even away from this extreme, it would be the (unobservably) least healthy who would be attracted to the DI program to gain access to its Medicare provisions. For these people, actual expenditures on Medicare would underestimate the true value of the Medicare benefit since, in its absence, they would not be able to find health insurance in the private market at a fair price, and consequently and non-optimally would spend little on health care.

This preceding argument holds even if there is no moral hazard created by health insurance in the consumption of health care. The existence of moral hazard caused by Medicare coverage (and the inability of insurers to identify and root out inappropriate or unnecessary care) would mean that DI recipients are spending too much on medical care. That

is, the marginal utility from Medicare expenditures is less than the marginal utility from other expenditures in the disabled state. Thus, actual Medicare expenditures by DI recipients, in the presence of moral hazard, would overestimate its value to the recipient. These considerations motivate the final necessary condition:

Condition 3: There are no informational asymmetries between insurers and the disabled causing adverse selection or moral hazard problems in private health insurance markets.

2.2 *Violating the Optimality Conditions*

If all three conditions simultaneously hold, then in the context of our framework, the average net present value of expenditures on Medicare by DI recipients correctly reflects the *ex ante* value of the Medicare benefit (before the uncertainty by people about the occurrence of a disability is revealed). Clearly, however, some of these conditions do not hold in the real world.

Condition 1 would be violated if the government did not accurately estimate the correct amount that should be spent on disability insurance. Suppose the other two conditions hold but the government requires too much to be spent on disability insurance—that is, the marginal utility of private expenditures exceeds the marginal utility of expenditures on disability insurance. It seems likely in this case that expenditures on Medicare by DI recipients will be too high (since too much is allocated to disability insurance), and Medicare expenditures will thus overestimate the true value of the Medicare benefit. On the other hand, if the government requires too little to be spent on disability insurance (again assuming conditions 2 and 3 hold), the opposite is likely to be true. Of course, people are likely to differ in their risk aversion, for one, and in their tastes for private goods relative to their tastes for health care. Because the government must (within fixed income and marginal tax categories) choose a single level of disability insurance for the population, even if the government sets the amount spend on DI

correctly on average (in some unspecified sense), it is likely to miss high for some segment of the population, and miss low for another segment. Since we know of no evidence that has been brought to bear on this essentially empirical question, we can proceed no further in guiding the reader in the likely direction of bias from a violation of condition 1.

Condition 2 would be violated if, conditional the amount allocated to disability insurance, the government did not balance cash payouts and Medicare benefits for DI recipients correctly. Assume now that condition 1 and condition 3 hold. If Medicare and cash benefits are set such that the marginal utility of Medicare is lower than the marginal utility of derived by the cash benefits, then the discounted sum of Medicare expenditures will overestimate the value of the Medicare benefit. If Medicare and cash benefits are set such that marginal utility is higher than the marginal utility from cash benefits, then the discounted sum of Medicare expenditures will underestimate the value of the Medicare benefit. As in the previous paragraph, heterogeneous tastes and risk aversion in the population means that even if the government gets things right on average, it will miss the target in both directions for some part of the disabled population. Again, there is little empirical evidence that we are aware of that has been brought to bear on this condition.

We have already discussed the consequences of relaxing the third condition—adverse selection means implies the discounted sum of Medicare expenditures understates the true value of DI's Medicare benefit, while moral hazard implies that the discounted sum overstates the true value. We note, however, that in this setting of people with heterogeneous and sometimes hard to measure disabilities, adverse selection is likely to be a more severe problem than moral hazard. Indeed, XXX (20xx) provide evidence that disability recipients have a low (relative to the non-disabled) price elasticity of demand for medical care. (Of course a zero price elasticity

would mean no moral hazard). Thus, if the other two conditions hold, the discounted sum of expenditures that we report are likely to be a lower bound on the true value of the Medicare benefit.

3.0 DETERMINANTS OF DI APPLICATION

[In this section, we develop hypotheses about factors that are likely to increase or decrease the probability of DI application, all else equal. Given the focus of this paper, we concentrate primarily on factors that change the relative value of Medicare eligibility. THIS SECTION IS INCOMPLETE]

Current health insurance coverage. – In general, we hypothesize that people with current health insurance coverage through their own employer will be less likely to apply for DI than people who lack such coverage. This is because people have to stop working and forgo their employer-sponsored insurance benefits (except via COBRA) in order to apply for DI. This is not strictly a comparative static, since it's conditional on the availability and cost of retiree benefits. But in general, retiree benefits will be less available than employee coverage, and more expensive.

Retiree health insurance coverage. – For people with current health insurance coverage through their own employer, the effect on DI application of the availability of employer-sponsored retiree benefits is ambiguous. On the one hand, it reduces the opportunity cost of forgoing current employer-sponsored coverage, which should increase the probability of DI application. On the other hand, it reduces the value of Medicare eligibility, by providing access to group (as opposed to individually-underwritten) insurance coverage independent of Medicare.

Retiree plans differ in the extent to which retirees or employers pay current premiums. Such plans in which retirees contribute little or nothing to the current premium particularly lower the value of Medicare eligibility through DI, because the retirees have in effect already paid for the retiree coverage through lower total compensation during their working years (Pauly, 19XX).

Coverage available through the spouse. – The effects on DI application of group health insurance coverage being available through a spouse are, in general, the same as the effects of the availability of retiree benefits through the person's own employer. We note that employers contribute relatively less towards the health insurance premium of spouses than to the premiums for active or retired employees.

Current private coverage. – We expect that individuals with current, privately purchased health insurance coverage are less likely to apply for DI, all else equal, because the private coverage reduces the value of Medicare eligibility relative to the case where the person had not private coverage.

Current public coverage. – We expect that current public health insurance coverage (e.g., Medicare, VA/CHAMPUS) reduces the probability of DI application, because it lowers the relative value of Medicare.

Age. – As we describe below, we examine patterns of health insurance coverage by DI application status over a six year period for the cohort of respondents in the Health and Retirement Survey. In general, we expect that the effect of age on the association between insurance characteristics and DI application is ambiguous. On the one hand, higher age reduces the value of DI participation and Medicare eligibility, all else equal, because people use the benefit for fewer years (i.e., until age 65). On the other hand, higher age typically reduces the opportunity cost of DI application, because the cumulative costs of an interruption in a person's

employment history are lower. We note that there are some non-linearities of the value of DI benefit and Medicare eligibility by age. In particular, the required two-year waiting period from DI award to Medicare eligibility means that Medicare plays no role in DI application decisions for people over age 63. At the same time, the availability of Social Security early retirement benefits as of age 62 reduces the value of DI application at that point.

4.0 DATA

We conduct our empirical analysis in two steps. First, we use the Medicare Current Beneficiary Survey (MCBS) to estimate the mortality and time discounted sum of Medicare expenditures by disability recipients who qualify for DI at different ages, and who have different qualifying disabling medical conditions. Second, we use the Health and Retirement Survey (HRS) to evaluate the importance of the Medicare benefit in inducing people with differing availability of health insurance from alternate sources and differing health status to apply for DI. In this section, we briefly describe these datasets and how we construct our analytic samples from them.

4.1 MCBS

The MCBS is a longitudinal survey covering a nationally representative sample of around 12,500 Medicare beneficiaries per year. DI participants are oversampled to permit separate analyses of this population, with a sample size of 2000 per year. The MCBS collects detail on health status and health care use and costs.² MCBS data are available to researchers by agreement with the Health Care Financing Administration.

²While these data have been used to estimate the distribution of out-of-pocket costs for Medicare beneficiaries overall, we are not aware of separate published actuarial calculations for DI beneficiaries.

The MCBS has been conducted annually since 1992, and we use the 1992-1998 data here. The MCBS uses a rolling panel design, with individual respondents being followed for four years and then replaced. In the present analyses, treat each person-year of data as independent, and we pool all person-years for a combined sample size of 14,394. Except where noted, analyses using MCBS data are weighted to be representative of the underlying population of Medicare beneficiaries, in this case Medicare beneficiaries on DI.

4.2 *HRS*

For comparisons between DI applicants and non-applicants, we use data from the first four waves of interviews of the Health and Retirement Survey, a multi-purpose social science survey conducted by the Survey Research Center (SRC) at the University of Michigan and funded by the National Institute on Aging. The first wave of the survey was conducted in 1992/93; respondents were re-interviewed in 1994 and at two-year intervals since then. We use the current public data files available at the time of this writing. The HRS is described in additional detail in Juster and Suzman (1995).

The HRS covers a representative national sample of non-institutionalized men and women born between 1931 and 1941 (inclusive), so that respondents in the sample frame were aged 50-62 at the time of the first wave. In addition, the HRS covers the spouses of age-eligible respondents, regardless of age. The HRS oversamples Blacks, individuals of Mexican descent, and residents of the state of Florida to permit reliable analysis of these groups. The first wave of HRS was conducted. The total sample size of the first wave is 12,654 respondents (82% response rate). Subsequent waves were conducted by telephone. The second wave re-interviewed 11,492 respondents (92% of the original sample); the third wave re-interviewed

10,618 (84% of the original sample); and the fourth wave re-interviewed 10,255 (81% of the original sample).

4.2.1 *Study Sample*

For our study, we begin with the sample of age-eligible Wave 1 respondents.³ We then restrict the sample to people who were working for pay and had never applied for DI prior to the Wave 1 survey. Finally, because we want to examine DI application between Wave (t) and (t+1), we exclude people who died by Wave 2 or otherwise did not respond to the Wave 2 survey. The resulting sample includes 5037 people.

For our Wave 2 sample, we begin with the Wave 1 sample. We then exclude individuals who died by Wave 3 or otherwise did not respond to the Wave 3 survey; those who applied for DI prior to Wave 2 (i.e., between Waves 1 and 2); and individuals who reached age 63 by Wave 2 or 65 by Wave 3 (because DI application will not hasten Medicare eligibility for this group).⁴ Our Wave 2 sample includes 4297 people. Finally, our Wave 3 sample is constructed using the same criteria as our Wave 2 sample, with reference to the Wave 3 and 4 surveys. Our Wave 3 sample includes 3292 people.

4.2.2 *Measures*

In this section, we briefly describe the data elements (DI application status, demographic and health information, and health insurance status) that we use from the extensive HRS questionnaires and how these elements are measured. Because the HRS surveys changed

³ We use data on respondent's spouse regardless of whether the spouse is age-eligible.

⁴ We initially considered also excluding people who were not working at Wave 2 (i.e., who had stopped working since Wave 1 but not applied for DI). However, the DI application rate between Waves 2 and 3 for this group was more than twice as high as for people in our sample who were working at Wave 2, suggesting that this was an important group to retain here.

substantially over its four waves, it occasionally requires considerable effort to guarantee that the data elements are consistently measured throughout.

DI application status. – HRS respondents were asked whether they have applied for DI, the status of their DI application (including whether they were ever awarded DI), and whether they are currently DI beneficiaries. From these variables, we create a dichotomous indicator of whether respondents applied for DI between Wave (t) and (t+1).

Among other criteria for qualifying for DI, people need to have been employed in job covered by Social Security for 20 of the previous 40 quarters (this is referred to as having “disability insured status”; Social Security Administration, 2001). We note that there is no definitive way to identify whether respondents meet this criterion using the public HRS datafiles. For respondents who provided permission, HRS survey data are matched to Social Security earnings records, which do allow definitive identification of disability insured status. However, access to these data is restricted and requires a federally-funded research project (among other criteria); the restricted data were thus not available for this study. Part of our motivation for focusing on HRS respondents who were employed at Wave 1 is to eliminate many of the respondents without sufficient work history to qualify for DI.⁵

Demographics and Health. – HRS respondents reported their age at the time of interview, and whether they were currently married, working for pay, and had a health problem that limits the kind or amount of paid work they can perform. In addition, HRS respondents were asked whether a doctor ever told them that they suffered from any of eight chronic diseases (high blood

⁵ We recognize that the HRS contains fairly detailed information about prior work history. In future work, we intend to use those data to develop a proxy for disability insured status, but this was outside the scope of the current project due to the complexity of the data.

pressure, diabetes, cancer except skin cancer, lung disease except asthma, heart disease, stroke, nervous or psychiatric problems, and arthritis or rheumatism).⁶

Health Insurance. – Respondents were asked if they had health insurance through a current or previous employer or union, or (if applicable) their spouse’s current or previous employer or union. The surveys do not distinguish between current and former employers. Also, for respondents who did not currently have insurance through their own employer/union, the survey did not assess whether such coverage was available in principle.

Respondents who reported having coverage through their employer/union were asked whether it was paid for entirely by the beneficiary, entirely by the employer/union, or by both.⁷ They were also asked whether their current health plan, or any other health insurance plan, was available to retirees; if so, respondents were asked whether the retiree coverage was paid for entirely by the beneficiary, entirely by the employer/union, or by both.⁸

We note several limitations to the questions about retiree coverage. First, the questions were only asked of individuals who reported currently having having employer-sponsored health insurance, and in reference to the employer/union that sponsored that coverage. Thus, for instance, respondents who had coverage through their spouses were asked about the availability of that coverage to retirees – but not whether their own employer (if any) offered retiree coverage. Second, in Waves 1 and 2, the survey did not assess the age at which retiree coverage would be available to the respondent. Starting in Wave 3, however, respondents were asked whether, if they left their employer now, they could continue their health coverage until age 65.

⁶ There are some differences in how the questions about chronic illness are asked across waves. In particular, from Wave 2 on, each successive survey instrument included information on the respondent’s responses in the prior wave, with a presumption that a positive response in the prior wave would yield a positive response in the current survey.

⁷ The question does not specify the types of costs to which it refers, e.g., plan premiums and/or the cost of health care services. It seems likely to us that the interviewers meant it to refer to premiums, and that most respondents interpreted it this way.

⁸ The question also does not specify the types of costs to which it refers.

Third, the survey did not explicitly distinguish between retiree health benefits *per se* and coverage available through the Comprehensive Omnibus Budget Reconciliation Act (COBRA) program, which mandates that individuals who had been covered by employer-sponsored health insurance be able to continue this coverage – at their own expense – for 18 months if they leave their jobs. The changes to the Wave 3 instrument described above addressed this for most respondents by asking whether coverage would be available to age 65.

Respondents were asked whether they had any kind of public health insurance, with follow-up questions asking about coverage through Medicare, Medicaid, and VA/CHAMPUS (available to some veterans and current and retired military personnel). Finally, respondents were asked whether they had any kind of private health insurance coverage. At Waves 1 and 2, the private insurance question was followed by prompts regarding insurance for dental care, long-term care, and hospital care. At Wave 3, the survey separated the question about hospital coverage from the questions about dental or long-term care.

For married respondents, identical health insurance information is available on their spouses. In particular, spouses reported whether they had health insurance coverage through their own (current or former) employer or union; and, if so, whether they were eligible for retiree coverage through that employer/union. As discussed above for respondents, spouses who did not currently have health insurance coverage through their own employer/union were not asked whether such coverage was available in principle, nor whether retiree benefits would be available for themselves or their spouses.

5.0 METHODS

In this section, we describe how we analyze the MCBS to arrive at discounted lifetime Medicare expenditures for DI recipient by age of enrollment, and we describe how we analyze the HRS to evaluate the effect of the Medicare benefit on application rates.

5.1 *Assessing the Economic Value of Medicare for DI Recipients*

Empirically, we estimate the distribution of Medicare costs paid for DI beneficiaries. Constructing age-specific profiles of costs invariably runs into a problem of sample size. Even in a large, nationally representative sample such as the MCBS, the sample size at a single age turns out to be quite small to construct reliable estimates of disability. To address this problem, we rely on the idea that Medicare expenditures should change smoothly across ages. Therefore, we take the raw age-specific estimates of expenditures and smooth them across ages, to construct an age-specific expenditure profile.

In order to describe the method we use to produce smooth age-specific prevalence functions—the overlap polynomial method⁹—it is helpful to introduce some notation. In this method, we treat the MCBS as a repeated cross section with N observations.¹⁰ Each observation i , taken in $year_i$, consists of information about i 's Medicare expenditures d_i and age_i .¹¹ Given these data, we estimate the following weighted OLS model of Medicare expenditures (where the weights are the sampling weights provided with the MCBS):

$$d_i = c + g_1(age_i, \beta_1) + g_2(year_i, \beta_2) \quad (1)$$

⁹ MaCurdy, Green, and Paarsch (1990) are the first to use this method in economics. Bhattacharya, Garber, and MaCurdy (1997) use this method to smooth cause-specific mortality profiles for the elderly.

¹⁰ This effectively throws away information since, as we note above, the MCBS is in truth a panel data set. However, our estimates are consistent despite this. Modifications to our method that take advantage of the panel data structure of the MCBS would yield increased efficiency.

¹¹ It is possible to adapt this method to use other covariates.

The g functions allow Medicare expenditures to flexibly vary with the year of observation and the age-cohort of the respondent. Age-cohort enters the model through g_1 , which is specified using an overlap polynomial:

$$g_1(\text{age}_i) = \sum_{j=0}^K \left(\Phi\left(\frac{\text{age}_i - k_{j+1}}{\sigma_1}\right) - \Phi\left(\frac{\text{age}_i - k_j}{\sigma_1}\right) \right) p_j(\text{age}_i; \beta_{1j}), \quad (2)$$

where $p_j(\text{age}_i; \beta_{1j})$ $j = 0, \dots, K + 1$ are all n^{th} -order polynomial in age_i . The knots are $k_0 \dots k_{K+1}$, and σ_1 is a smoothing parameter, which in addition to n , are all fixed before estimation. We use first-degree polynomials. Though we experimented with higher order polynomials, we find that they add to the costs of computation with no change in the final projections.

With this smoothing technique, the knots define age intervals. When the smoothing parameter approaches zero, the age-profile over each interval simply equals the within-interval average expenditures. In this case, the age-profile reduces to a step function, where each step equals the within-interval average disability.¹² As the smoothing parameter increases, the estimator uses increasingly more information from outside each interval. In the extreme, as the smoothing parameter approaches infinity, there is no meaningful distinction between any two intervals. Allowing nonzero values of the smoothing parameters eliminates the sharp discontinuity of the growth rates at the knots. One advantage of overlapping polynomials over traditional splines is that the function and all its derivatives are automatically continuous at the knots without imposing any parameter restrictions.

¹² When this is the case, $\Phi(\cdot)$ reduces to an indicator function equal to zero if $\text{age} < k_j$ and one if $\text{age} \geq k_j$. Thus

the first term of the sum, $\left(\Phi\left(\frac{\text{age}_i - k_1}{\sigma_1}\right) - \Phi\left(\frac{\text{age}_i - k_0}{\sigma_1}\right) \right) p_0$, equals p_0 when $k_0 < \text{age} \leq k_1$, and zero otherwise. Between k_0 and k_1 , the rate of disability is given by p_0 , which in turn depends on the parameters $\beta_{1,0}$.

In addition to an overlap polynomial for age, we also include another overlap polynomial, g_2 , for year to flexibly allow for changes in the age-prevalence relationship over time. Here, the knots are $m_j, j = 0 \dots M$, the smoothing constant is σ_2 , and q_j are the polynomials. As before experimentation led us to use first order polynomials in year.

$$g_2(\text{year}_i) = \sum_{j=0}^M \left(\Phi \left(\frac{\text{year}_i - m_{j+1}}{\sigma_2} \right) - \Phi \left(\frac{\text{year}_i - m_j}{\sigma_2} \right) \right) q_j(\text{year}_i; \beta_{2j}) \quad (3)$$

The object of the estimation is to obtain consistent estimates for β_1 and β_2 — $\hat{\beta}_1$ and $\hat{\beta}_2$ respectively. Using these estimates, it is straightforward to generate age-specific expenditure profiles representative for any particular year. Let $\rho_{t,a}$ be the predicted expenditures among a -year olds in year t . Then,

$$\rho_{t,a} = \frac{1}{N} \sum_i \hat{c} + g_1(\text{age}_i, \hat{\beta}_1) + g_2(\text{year}_i, \hat{\beta}_2) \quad (4)$$

Next, we then integrate over the age trajectory to calculate the cumulative discounted value of Medicare expenditures through age 64, for different ages of initial participation in Medicare. Effectively, we assume (for example) that for a 60 year old DI recipient, average Medicare expenditures next year will equal that of an average 61 year old DI recipient today. Two year from now, they will equal that of an average 62 year old DI recipient today, and so on. To be concrete, let $V(a, y)$ be cumulative discounted value of Medicare expenditures for someone who joins the DI program at age a and in year y . Let r be a fixed rate of time discounting. We calculated $V(a, y)$ using:

$$V(a, y) = \sum_{\text{age}=a}^{64} \frac{S_{\text{age}}}{(1+r)^{\text{age}-a}} \rho_{y,\text{age}} \quad (5)$$

In equation (5), S_{age} represents cause-specific survivor functions that reflect actual DI exit rates (including both mortality and recovery).¹³ In practice, recovery rates by DI recipients are quite low and so exit rates from DI-supplied Medicare coverage (prior to attaining retirement age) are dominated by recipient mortality—see Dykacz and Hennessey (1989); Hennessey and Dykacz (1993); and especially Zayatz (1999).

Finally, after converting all $V(a, y)$ to 1998 dollars using the standard consumer price index (CPI), we average over the predictions for the different years in our data to arrive at our final prediction:

$$V(a) = \frac{1}{7} \sum_{y=1992}^{1998} V(a, y) \quad (6)$$

Because we expect that medical costs vary systematically by beneficiaries' health status, we examine DI beneficiaries overall and within subgroups defined by their primary medical diagnosis. Due to limited sample size, however, we are only able to examine relatively prevalent causes for DI eligibility, including back problems, arthritis, stroke/seizure disorders, cardiovascular disease, mental illness, and mental retardation. Together, these categories account for approximately half of SSDI beneficiaries, and are among the most important causes of severe disability in the United States, as we discuss below.

5.2 *Evaluating the Effect of the Medicare Benefit on DI Application*

As we have discussed, little information has been published to date about the health insurance coverage of DI applicants. We thus focus on providing descriptive characteristics about the health insurance status of DI applicants in our sample, at the time of the HRS survey

¹³ We use age-at-enrollment-specific mortality and recovery hazards from Zayatz (1999).

immediately preceding their DI application. For comparison, we provide information on two additional groups of HRS respondents: all those in our study sample who do not apply for DI during the relevant period, and the subset of those non-applicants who reported that health limits the type or amount of paid work they can do. The first comparison group is obviously likely to include many people who are not “at risk” for DI application because they are not disabled. The second group is substantially more likely to report themselves as “disabled” – in the sense of having health limit their ability to work – than DI applicants, and there are presumably systematic reasons why they have nevertheless not applied for DI (including the possibility that they do not have disability insured status).

For these three groups, we tabulate demographic, health insurance, and morbidity data. Because of likely gender differences in work history, job characteristics, and other factors that may affect labor force behavior, we tabulate characteristics separately by gender. Analyses using HRS data are weighted to be representative of the underlying population, using the HRS’s person-level analysis weight for the relevant survey wave. The HRS’s person-level weights are structured to match the Current Population Survey, which includes living, non-institutionalized respondents. A respondent who is institutionalized at the time of the interview will have a person-level weight of zero for that wave.

6.0 FINDINGS

In this section, we present the results of our empirical analyses.

6.1 The Value of the Medicare Benefit

Table 1 presents demographic statistics from the sample of MCBS DI Beneficiaries—that is, all Medicare beneficiaries under the age of 65 who are not end-stage renal disease patients. This sample includes DI recipients, whether or not they consumed any Medicare dollars. The average age of DI recipients was 49 years, while the average age of the U.S. population generally is 34. Nearly 60% of DI recipients are male, whereas for the U.S. as a whole, there were 95.5 males to 100 females in 1998 (including those over 65, where females outnumber males by a 10:7 ratio). 17% of the DI population is Black, relative to 11.4% of the population over 18. Finally, 42.5% of the DI population did not complete high school, compared with 17% of the general population over the age of 25.

Table 2 presents shows the percent of the DI population by primary cause of DI eligibility, as reported in the MCBS. Mental illness is the modal identified cause of DI reciprocity (15% of all DI recipients). These patients are also among the youngest recipients at an average age of 44 and the least likely to be married at 21.5%. Patients with mental retardation (7.6% of DI recipients) are even younger (40.8 years old) and less likely to be married (5.4%) than patients with other mental illnesses.

Disability resulting from chronic diseases and severe acute events such as strokes (5.3% of DI recipients) and cardiovascular disease (10.3% of DI recipients) are nearly as common as mental illness and retardation as causes of DI reciprocity. However, these patients tend to be older (55 years old in the case of cardiovascular conditions and 50 years in the case of stroke) and much more likely to be married. Similarly, patients with arthritis (7.1% of DI recipients) and with back, spine, or disc injuries (11.3% of DI recipients) are on average older than 50 years, and more likely to be married. To the extent the spouses of DI recipients work and receive

health care coverage through their employer for their whole family, the Medicare benefit of DI is less likely to serve as a motivation for application and take-up of the DI benefit.

Figure 1 plots the cumulative present value of Medicare benefits by age of initial SSDI participation— $V(a)$ —for four different rates of time discount 0%, 2%, 5%, and 8%. Panel A plots this graph for male recipients, while panel B plots it for female recipients. Naturally, at 0%, the value of Medicare is decreasing in initial age of participation. At age 25, a lifetime of Medicare benefits to age 64 is worth over \$100,000 for females and over \$80,000 for males. This can be compared with the cash benefit from DI participation. At 0%, at \$8,700 per year, and taking into account exit hazards due mortality and recovery this benefit is worth roughly \$225,000 between age 25 and age 65. Thus, the cash value of Medicare the value of DI participation (for those starting at age 20) by over 44% for females and 36% for males. In fact, this 40% figure is approximately correct regardless of the age at initial participation. At all discount rates, the cumulative present value of the Medicare benefit appears higher for female recipients than for male recipients.

At more reasonable rates of time discount, the cumulative benefits take on an inverted “U” shape. This is because young recipients spend less on Medicare than older recipients—that is, $\rho_{t,a} > \rho_{t,a'}$ for all $a > a'$. Clearly, if a patient starts to receive DI at a young age and stays on the program, his spending on Medicare is likely to increase throughout his life. However, since these greater Medicare expenditures take place at later ages, *and are discounted*, lifetime payouts will be less than someone who joins DI at a later age and starts immediately with high levels of undiscounted Medicare expenditures. Clearly, the greater the discount rate, the later is the peak of the $V(a)$ curve. Thus, at the 2% discount rate, the cumulative present value of Medicare peaks for those joining DI at age 26 for males and at age 29 for females. At the 5% rate, it peaks for

those joining at age 36 for males and at age 32 for females, and at the 8% rate it peaks for those joining at age 40 for males and at age 35 for females.

Time discounting does not alter the fact that Medicare expenditures are a substantial portion of the DI benefit. For example, at the 2% rate, the discounted cumulative value of Medicare for those joining at age 25 is approximately \$71,730 for females and \$56,360 for males, while the discounted value of a yearly stream of \$8,700 in DI benefits is \$157,500 (taking into account exit hazards due mortality and recovery). Medicare represents roughly a 40% increase over the pecuniary stream of DI benefits, though it is obviously greater percentage of the total benefit for females than for males. At the 5% rate at age 25, the Medicare benefit is about \$36,000 for men and about \$45,300 for women, compared with the roughly \$100,000 discounted stream of DI benefits (a 36% increase for men and a 45% increase for women). And at 8%, the Medicare benefit is about \$25,100 for men and \$36,366 for women, compared with the roughly \$70,000 discounted stream of DI benefits (a 33% increase for men and a 48% increase for men).

Appendix Tables A1-A6 plot the $V(a)$ curves for DI recipients with different causes of disability and at different discount rates, again separately for men and women.¹⁴ We examine the most common causes of DI recipiency—cardiovascular illness, stroke/seizure, mental illness, mental retardation, arthritis, and back/spine/disc injury. Figure 2 summarizes these $V(a)$ curves for the various conditions at the 5% discount rate. Prior to age 30, there are too few recipients

¹⁴ Mortality and recovery hazards by age of initial DI enrollment and by primary medical cause of enrollment are nowhere available. However, hazards by age of initial enrollment are available in Zayatz (1999) and 4-year hazards by primary cause of the disabling condition are available for two DI enrollment cohorts (the 1972 and 1985 cohorts) in Hennessey and Dykacz (1993). To estimate the hazard by cause of and by age at enrollment, we multiply the age at enrollment hazards by the proportion by which the 4-year cause of enrollment hazards for the 1985 cohort exceed (or are less than by, as the case may be) the average 4-year hazard for all causes.

represented in the MCBS population to accurately plot the cumulative discounted present value curves, so we plot starting at age 30.

The heaviest female users of Medicare are DI recipients with strokes and seizures who enroll at an early age. Male stroke/seizure victims are also heavy Medicare users, though male patients with mental illnesses spend a little more over their lifetime on Medicare. Relative to the average discounted cumulative pre-65 Medicare benefit of approximately \$36,000 for men and \$45,300 for women, male cardiovascular patients who enroll at age 30 spend nearly \$50,000 on Medicare in cumulative discounted terms, while female cardiovascular patients spend nearly \$61,000.

For both males and females, DI recipients with mental illnesses are among the heaviest users at early ages, and for males, the heaviest users for those enrolling at later ages. Males mental health patients who enroll at age 30 spend a discounted sum over \$55,000 on Medicare, while females spend over \$65,500. For mental health patients, the relation between discounted cumulative expenditures and age of enrollment declines slowly, so that even those who enroll at age 55 can expect to spend a discounted \$38,000 (for males) and \$42,000 (for females) on Medicare between age 55 and 64. Since the average age of mentally ill DI recipients is only 44, Medicare expenditures on this group are high and remain so for a long time.

Among both male and female cardiovascular DI patients, the relation between discounted Medicare expenditures and entry age follow a path slightly lower than, but parallel to patients with a mental illness. However, since the average starting age of DI cardiovascular patients is older than the average starting age DI mental illness patients, and since the curves for both conditions are declining everywhere, discounted Medicare expenditures on cardiovascular patients are less per patient on than on patients with mental illness.

Among females, patients with mental retardation and those with mental illness follow similar $V(a)$ profiles. Male mental retardation patients who receive Medicare from age 30 spend considerably less on Medicare than 30-year-old male mental health patients also starting on Medicare. Male mental retardation patients who start on Medicare at age 45 and older, however have a discounted value of Medicare expenditures that is close to the pattern of male mental health patients. Since the average age of patients with mental retardation is 41 years, it seems that the left-most points on the curve are most important for them.

DI recipients with back/spine/disc injuries and recipients with arthritis have the second lowest and lowest $V(a)$ profiles (respectively) of the diagnoses that we examine. Unlike all the other conditions we have considered so far, male patients with arthritis or back/spine/disc injuries spend less on Medicare over their lifetime than do their female counterparts. Patients with these musculo-skeletal conditions also tend to be older on average (52 years for back/spine/disc patients and 53 years for other arthritis patients).

6.2 *The Medicare Benefit and DI Application Incentives*

In this section, we compare DI applicants with non-applicants in the HRS along several dimensions that illuminate the incentive effects of the Medicare benefit on DI application rates.¹⁵

6.2.1 *Characteristics of DI Applicants*

Table 3 presents descriptive information about the DI application rates, demographic characteristics, and health insurance coverage of DI applicants and two groups of non-applicants. Table 3a conditions on DI application status between HRS Waves 1 and 2; Table 3b conditions

¹⁵ While our analysis currently focuses on targeted and suggestive descriptive statistics, we plan to conduct a more formal regression-based analysis in the next version.

on application status between Waves 2 and 3; and Table 3c conditions on application status between Waves 3 and 4. For our Wave 1-2 sample, 2.6% of men and 3% of women applied for DI, and application rates were very similar for our Wave 2-3 and 3-4 samples, respectively.

6.2.2 *Health Insurance*

In Table 3a, male and female DI applicants are less likely to be married than both groups of non-applicants. Compared with the overall sample of non-applicants, DI applicants are significantly more likely report having a health problem that limits paid work; however, a minority of applicants report having such a problem at the beginning of the period. Compared with the overall sample of non-applicants, male and female DI applicants are significantly less likely to have current health insurance coverage through their own employer and to have employer-sponsored retiree benefits available (although, as noted above, this latter result may partly be an artifact of the former, since the HRS does not assess the availability of retiree benefits unless the respondent reports having current employer-sponsored coverage).

With respect to health insurance costs, there are no statistically significant differences in the distribution of costs for current health insurance between DI applicants and non-applicants. For retiree coverage, however, male and female applicants were much more likely to face the whole cost of retiree health insurance (if it was available).

Insurance coverage through respondents' own employer is notably lower among women than men. Among both applicants and non-applicants, however, this is largely made up by higher rates of coverage through a spouse; overall, approximately 65% of DI applicants and 85% of non-applicants have current health insurance through either their own or their spouse's employer, with rates slightly lower among women than men. In addition, male (but not female)

applicants were less likely than either group of non-applicants to have private health insurance. Female (but not male) applicants were much less likely than non-applicants to have a spouse with current health insurance through the spouse's employer (given the limitations of the HRS insurance measures, we view this as a proxy for whether respondents had access to employer-sponsored health insurance through their spouses).

In Table 3b, patterns are generally similar with respect to DI applicants and non-applicants as observed in Table 3a. One difference is that the sample now includes some respondents who were not working at the start of the period. Among men, DI applicants are significantly overrepresented in this group; among women, however, non-applicants with a work limitation are significantly overrepresented. Among men, DI applicants remain less likely than non-applicants to have current employer sponsored coverage and retiree benefits (although the latter difference is not statistically distinguishable from zero). Male DI applicants with employer-sponsored health insurance are more likely than non-applicants to report that their employer covers the whole plan cost, for both current coverage and retiree benefits. Among women, DI applicants are less likely than non-applicants to have health insurance through their own or their spouse's employers (and are again much less likely to be married). However, there are no differences in access to retiree benefits through the respondents' employer. Female applicants are more likely to have public insurance and less likely to have private insurance than non-applicants. Finally, both male and female applicants in this period are significantly less likely to have a spouse with current insurance coverage or available retiree coverage through the spouse's employer.

In Table 3c, patterns are generally consistent with those in the previous panels. Among men, DI applicants remain less likely to have health insurance through their own employer, but

the gap is narrower than in the prior periods. There are no statistically significant differences in availability of retiree benefits, or in the prevalence of insurance through a spouse's employer, or privately purchased or public health insurance. In this period, DI applicants and non-applicants are also similarly likely to have a spouse with health insurance coverage through the spouse's employer. Among women, DI applicants in this period are actually more likely to have insurance coverage through their own employer, although they remain less likely to have coverage through a spouse's employer; neither difference is statistically distinguishable from zero. However, female DI applicants remain less likely to have private insurance and are more likely to have a spouse with insurance coverage through the spouse's employer.

6.2.3 *Chronic Illness*

Tables 4a-4c present information on the prevalence of eight chronic illnesses among men and women in our three study periods, by DI application and health limitation status. Among men in the first study period (Table 4a), DI applicants have higher rates of all eight conditions than the overall sample of non-applicants; differences in diabetes, lung disease, heart problems, and arthritis are statistically significant ($p < 0.10$). Prevalence of these conditions is generally similar among DI applicants and non-applicants with a health problem that limits work. Among women, DI applicants similarly have high rates of all eight conditions than the overall sample of non-applicants, with all but one difference between statistically significant ($p < 0.05$ for 6 of 7, $p < 0.10$ for the eighth). In addition, prevalence for each condition except cancer was higher among female DI applicants than among non-applicants with a health problem that limits work.

For men in the second study period (Table 4b), patterns are very similar to the prior panel. The same is true for women, with the exception that differences between DI applicants

and the subset of non-applicants with a health problem that limits work have narrowed or disappeared; the main remaining difference is in arthritis. For men in the third study period (Table 4c), prevalence of each condition remains higher among DI applicants than the overall sample of non-applicants, although differences are smaller for most conditions than in the previous periods; the same general pattern holds for women.

Overall, our findings regarding morbidity of DI applicants and non-applicants confirm the obvious fact that DI applicants are in poor health relative to non-applicants.¹⁶

7.0 CONCLUSIONS

Medicare is a substantial part of the benefit that DI enrollees receive. At reasonable discount rates, Medicare expenditures increase payouts to DI enrollees by up to 40% over DI cash payments. The curve relating the cumulative present value of Medicare to the age of initial Medicare participation displays an inverse “U” shape, peaking between age 25 and 35, depending on the rate of time discount. While young DI enrollees with stroke or seizure can expect to spend the most on Medicare of all DI enrollees with common enrollment diagnoses, these patients are on average among the oldest DI recipients. On the other hand, young DI recipients with mental illnesses can expect to spend nearly as much, but are much younger on average than cardiovascular patients.

In comparing DI applicants with non-applicants, we most notably find that current employer-sponsored health insurance is less prevalent among DI applicants. For men, the main difference is in coverage through the respondents’ own employer/union, while for women that

¹⁶ We recognize that the current analyses do not enable direct comparison to our findings regarding the relative value of Medicare eligibility for different disabling conditions, which requires multivariate analysis to control for differences in prevalence of various conditions. We leave this to future analyses.

difference is reinforced by substantially lower prevalence of coverage through a spouse's employer/union among DI applicants. DI applicants are also less likely to have access to retiree benefits, but these differences are smaller and less consistent than the differences in current health insurance coverage. Retiree benefits both lower the value of Medicare eligibility (relative to potential applicants who lack access to retiree coverage) and—for people with current employer-sponsored coverage—reduces the opportunity cost of DI application, so that the net effect of retiree benefits on DI application cannot be signed *a priori*.¹⁷ There are few significant differences in the prevalence of public or private insurance by disability status, except that male DI applicants in the first period and female DI applicants in the third period are significantly less likely than non-applicants to have privately purchased insurance.

Our next steps in this research agenda include estimating the distribution of out-of-pocket costs paid by the beneficiaries, as well as estimating expenditures for different demographic subgroups (such as for married couples vs. singles). We will then calculate the value of Medicare relative to various alternative sources of health insurance. In particular, DI is likely to be particularly appealing to individuals without access to other sources of group health insurance, such as coverage through an employer-sponsored retiree plan, a spouse, or Medicaid, so we will estimate the value of Medicare separately for people with and without access to other insurance sources.

¹⁷ As noted above, we may be miscoding some individuals as lacking access to employer-sponsored coverage and retiree benefits using the available survey measures.

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Table 1: Descriptive Characteristics of SSDI Beneficiaries*

CHARACTERISTIC	MEAN or PERCENT
<i>Sample size</i>	<i>14,394</i>
Age (mean) <i>(SD)</i>	49.1 <i>(11.1)</i>
Gender	
Male	59.9%
Female	40.1%
Race/Ethnicity	
White (non-Hispanic)	75.6%
Black (non-Hispanic)	17.0%
Hispanic	3.8%
Asian	0.4%
Other	3.2%
Education	
< High School	42.5%
HS graduate	33.7%
Some college	13.8%
College Graduate	3.7%
Married	40.4%

SOURCE: Authors' calculations from 1992-1998 MCBS

***NOTE:** Results are weighted using population weights

Table 2: Primary Cause for SSDI Eligibility*

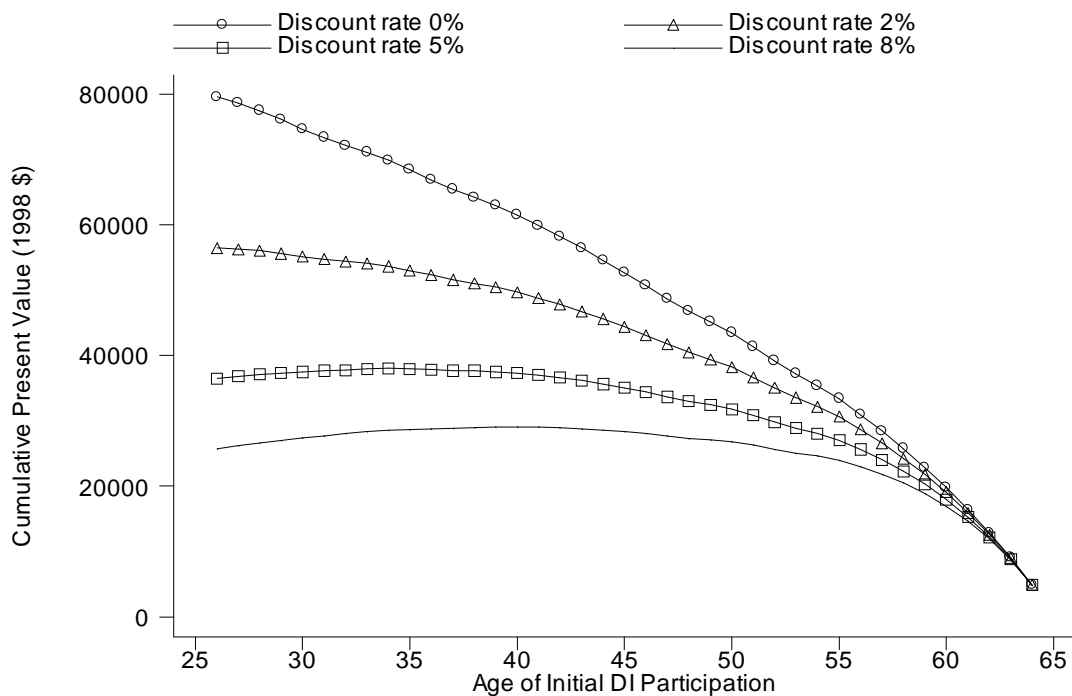
CAUSE	PERCENT	WITHIN CAUSE		
		Mean Age	Male	Married
Back/spine/disc	11.3%	52.3	66.0%	66.3%
Poor eyesight	3.9%	49.8	49.9%	42.9%
Poor hearing	1.0%	45.2	53.4%	22.8%
Kidney disease	0.6%	48.0	56.6%	47.5%
Stroke/Seizure disorder	5.3%	50.0	61.3%	40.9%
Car/bicycle/train accident	2.6%	48.3	68.8%	42.2%
Multiple sclerosis	1.8%	49.4	29.4%	61.3%
Muscular dystrophy	0.4%	47.8	54.7%	72.9%
Cerebral palsy	0.6%	45.9	45.3%	12.9%
Broken bones/hip	1.3%	53.5	77.9%	53.1%
Cardiovascular conditions	10.3%	55.0	65.1%	59.5%
Cancer	2.5%	51.7	49.7%	47.0%
Diabetes	1.7%	55.2	63.0%	59.2%
Arthritis	7.1%	53.3	51.9%	57.7%
Mental retardation	7.6%	40.8	59.2%	5.4%
Alzheimer's disease	0.1%	55.8	83.5%	38.1%
Mental Illness	14.9%	44.1	59.3%	21.5%
Osteoporosis	0.3%	52.9	32.6%	34.7%
Parkinson's disease	0.1%	47.5	59.2%	37.6%
Emphysema/asthma	1.9%	54.8	87.4%	19.8%
Partial paralysis	3.0%	55.1	55.3%	54.8%
Loss of limb	0.3%	47.6	75.4%	49.0%
Other cause	20.5%	50.4	81.3%	57.7%

SOURCE: Authors' calculations from 1992-1998 MCBS; sample same as Table 1

*NOTE: Results are weighted using population weights

Figure 1: Cumulative Present Value of Medicare Benefits for DI Beneficiaries—All Causes

Panel A: Males



Panel B: Females

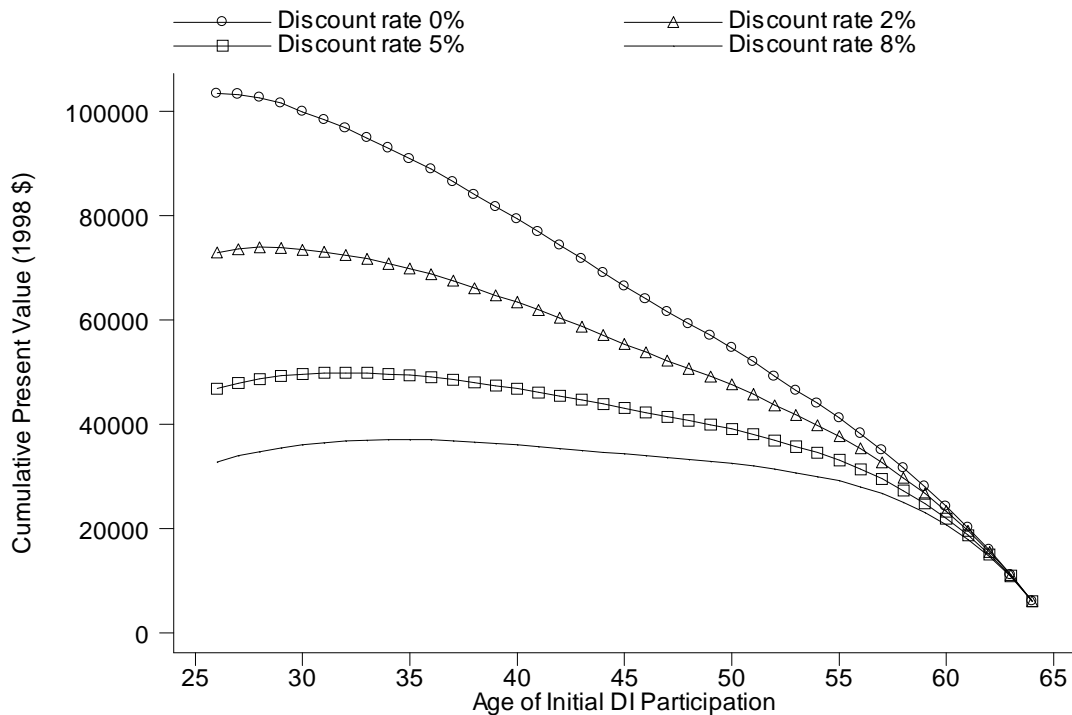
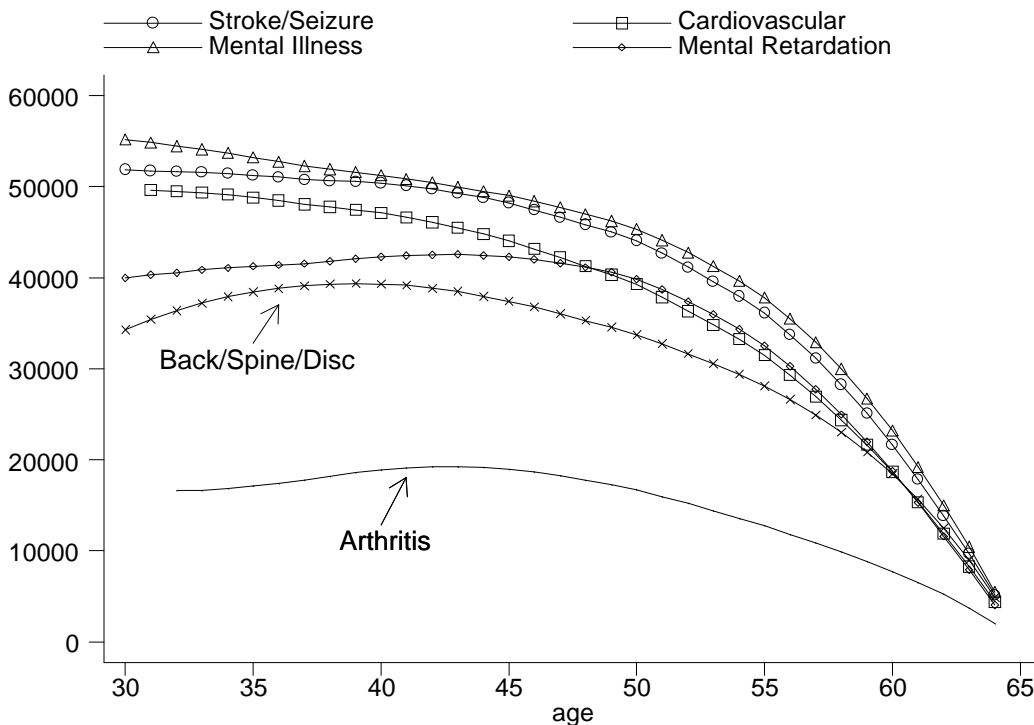


Figure 2: Cumulative Present Value of Medicare Benefits for SSDI Recipients by Cause of Disability (5% discount rate)

Panel A: Males



Panel B: Females

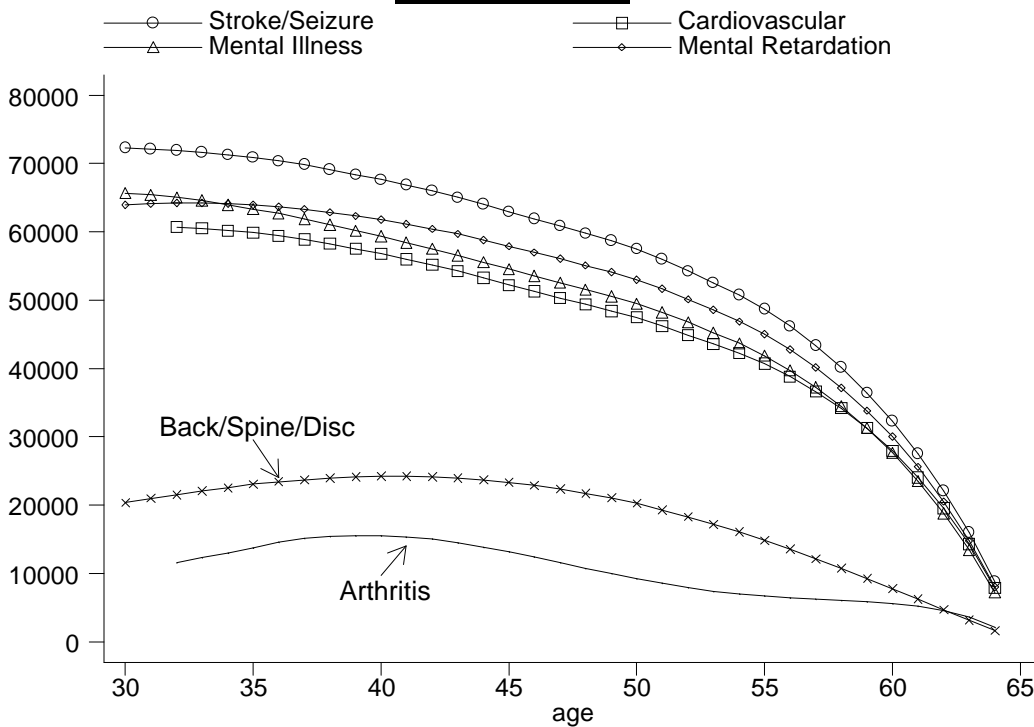
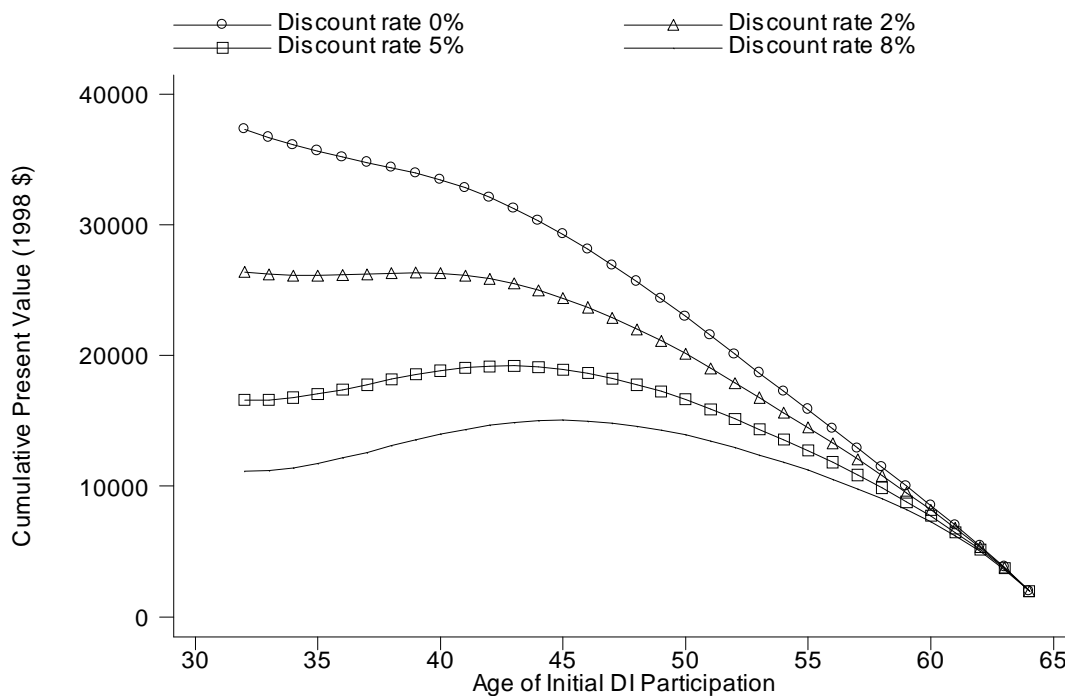
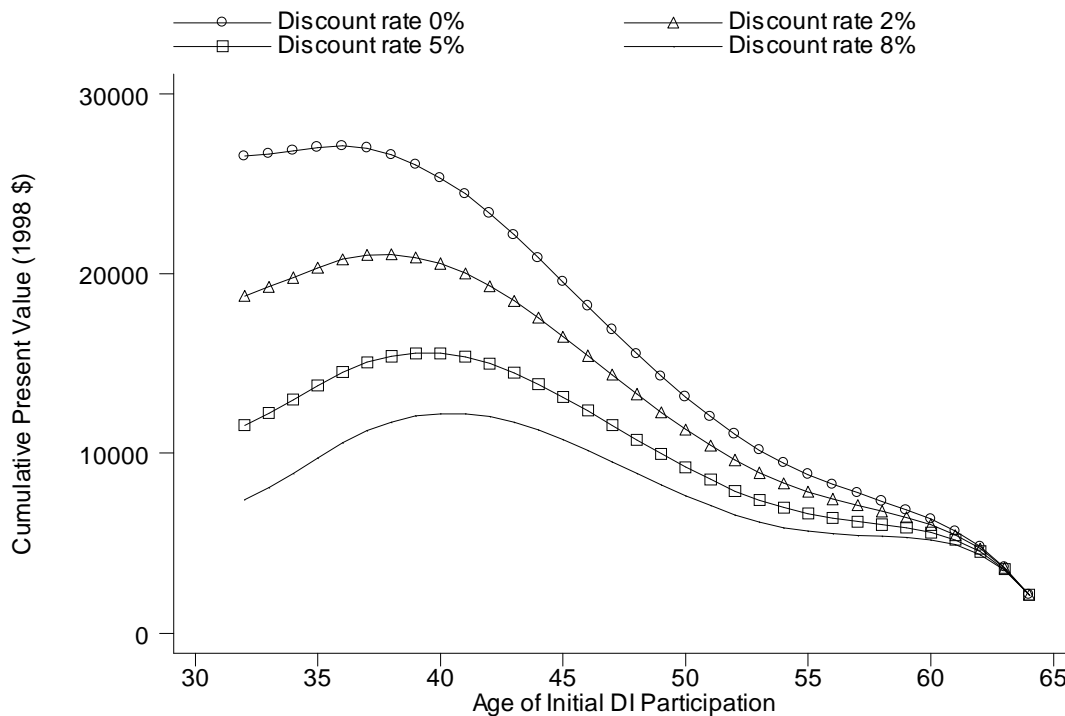


Figure A1: Cumulative Present Value of Medicare Benefits for SSDI Recipients—Arthritis

Panel A: Males

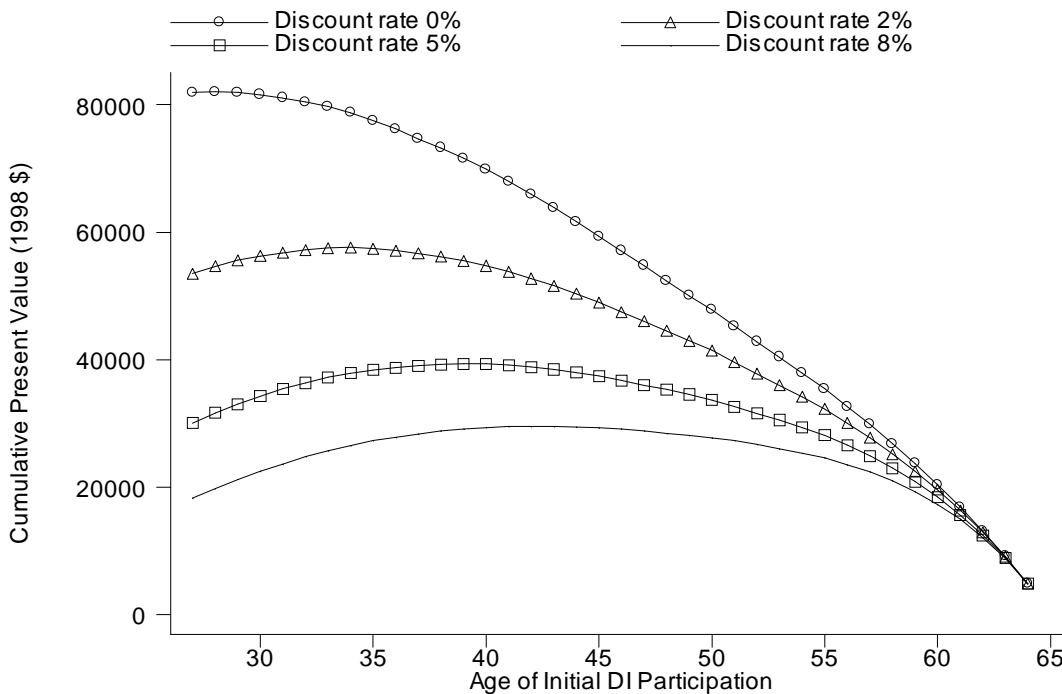


Panel B: Females

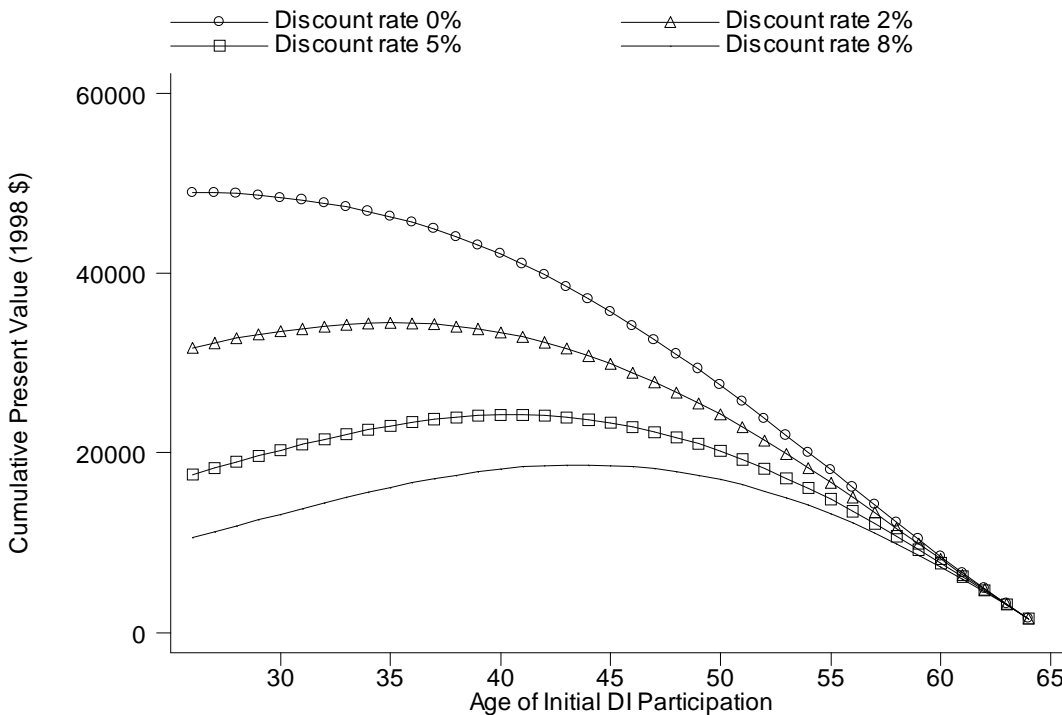


**Figure A2: Cumulative Present Value of Medicare Benefits for DI Recipients—
Back/Spine/Disc**

Panel A: Males

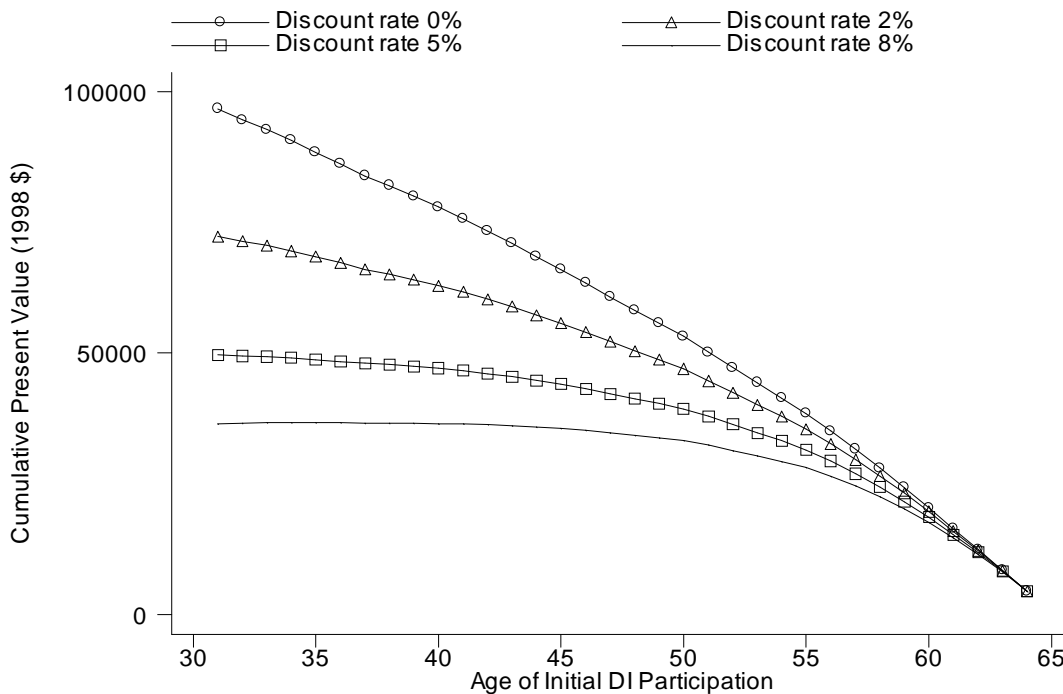


Panel B: Females

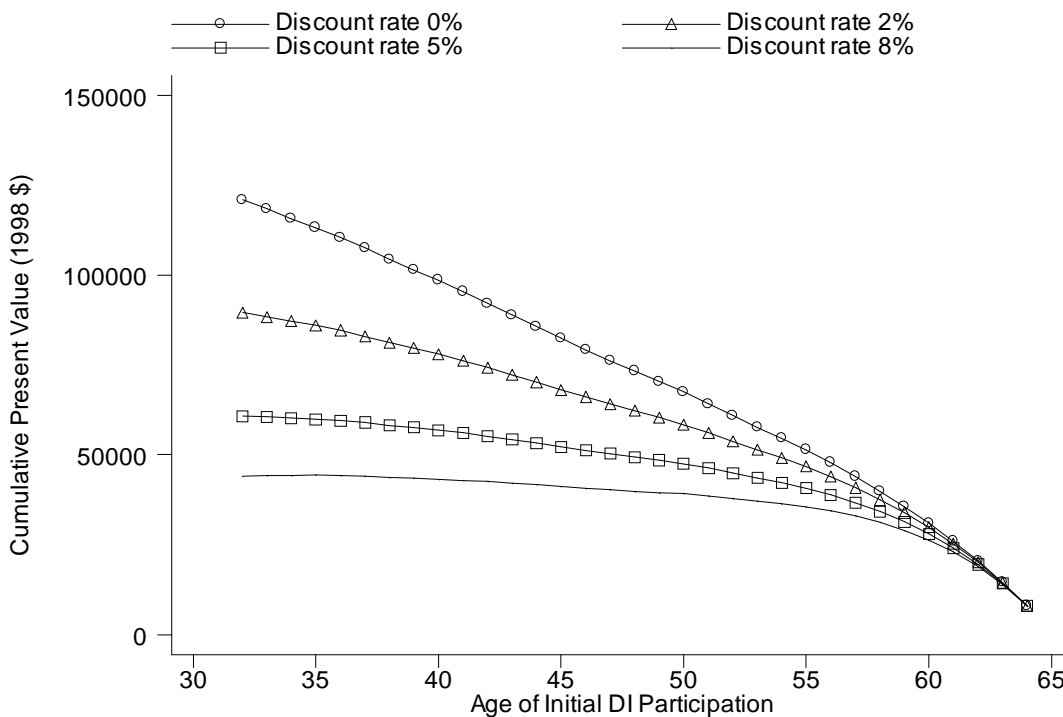


**Figure A3: Cumulative Present Value of Medicare Benefits for SSDI Recipients—
Cardiovascular Disease**

Panel A: Males

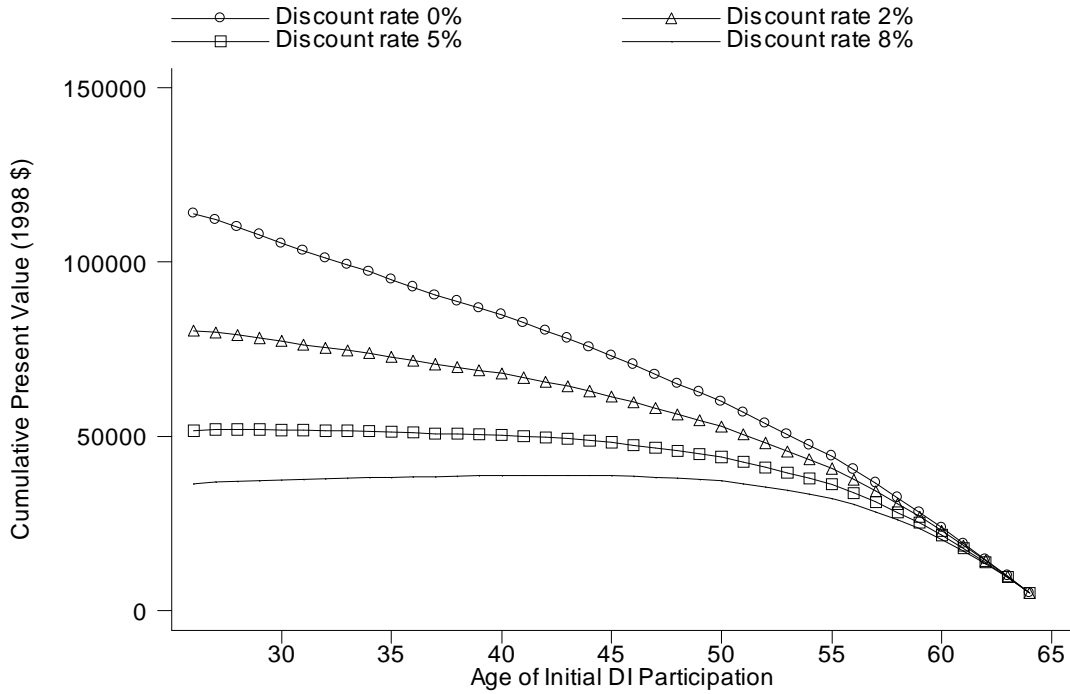


Panel B: Females



**Figure A4: Cumulative Present Value of Medicare Benefits for SSDI Recipients—
Stroke/Seizure Condition**

Panel A: Males



Panel B: Females

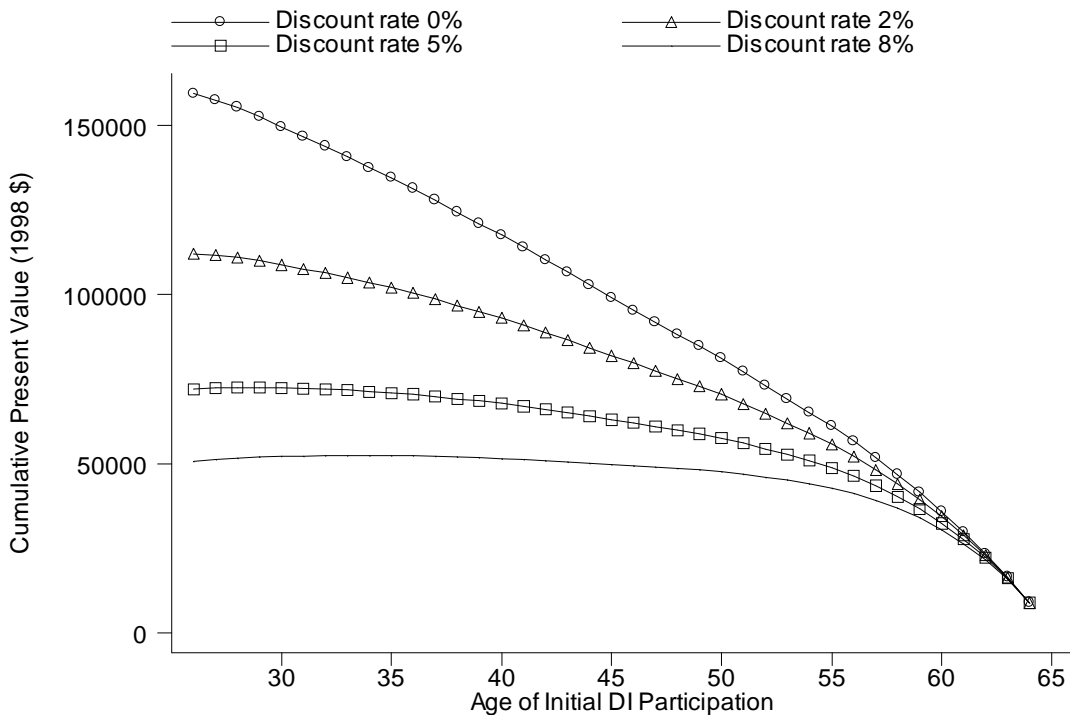
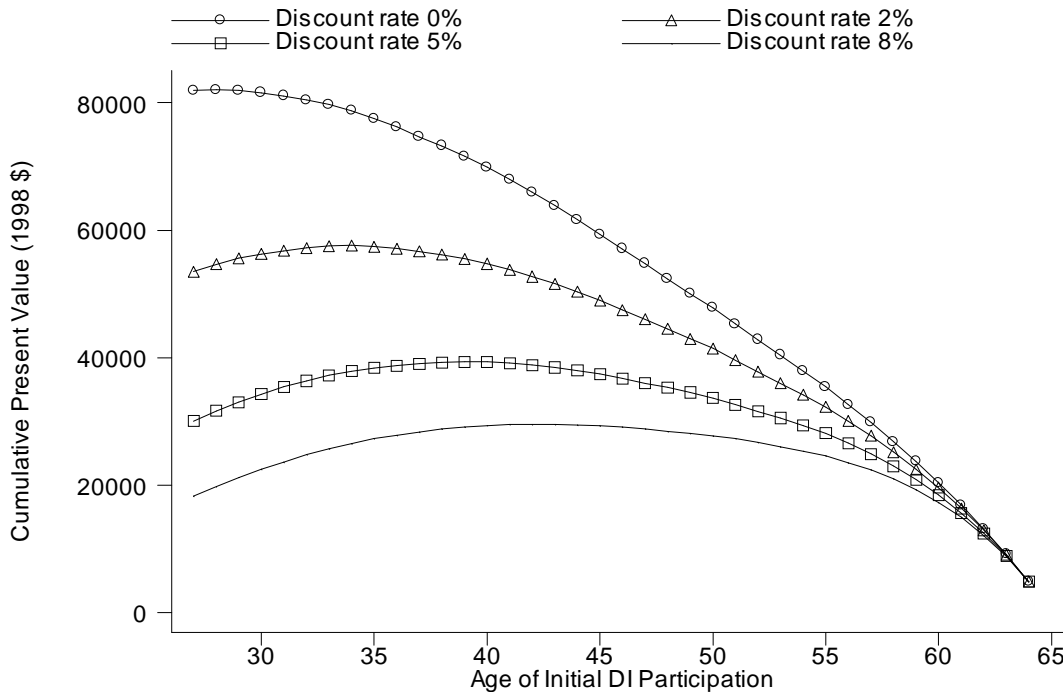


Figure A5: Cumulative Present Value of Medicare Benefits for SSDI Recipients—Mental Illness

Panel A: Males



Panel B: Females

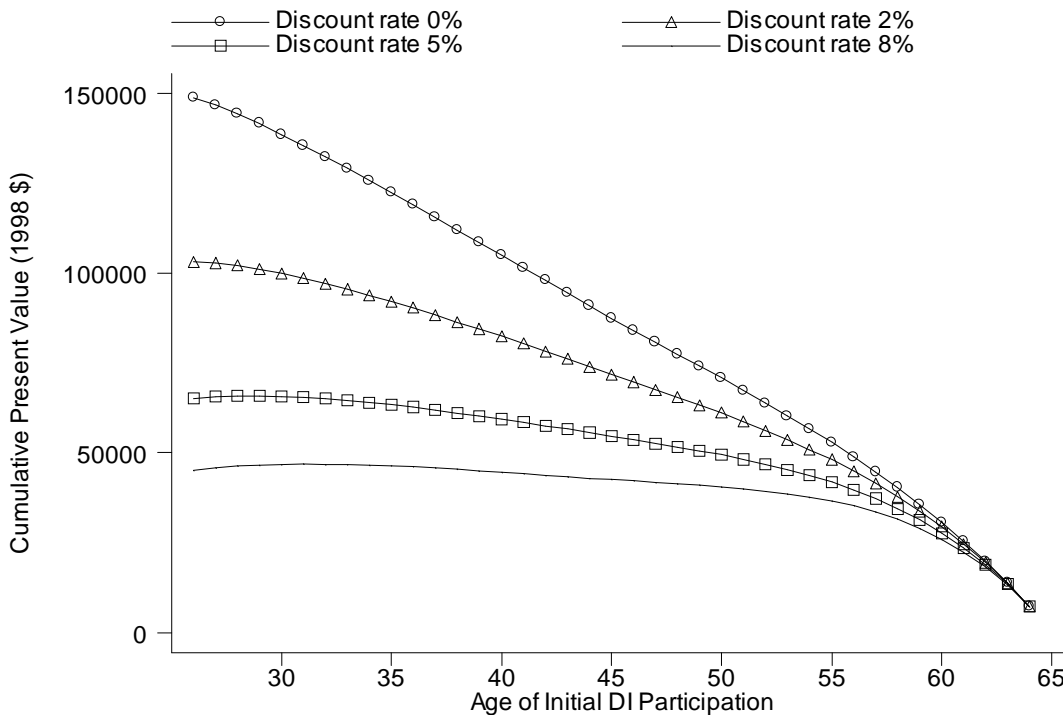
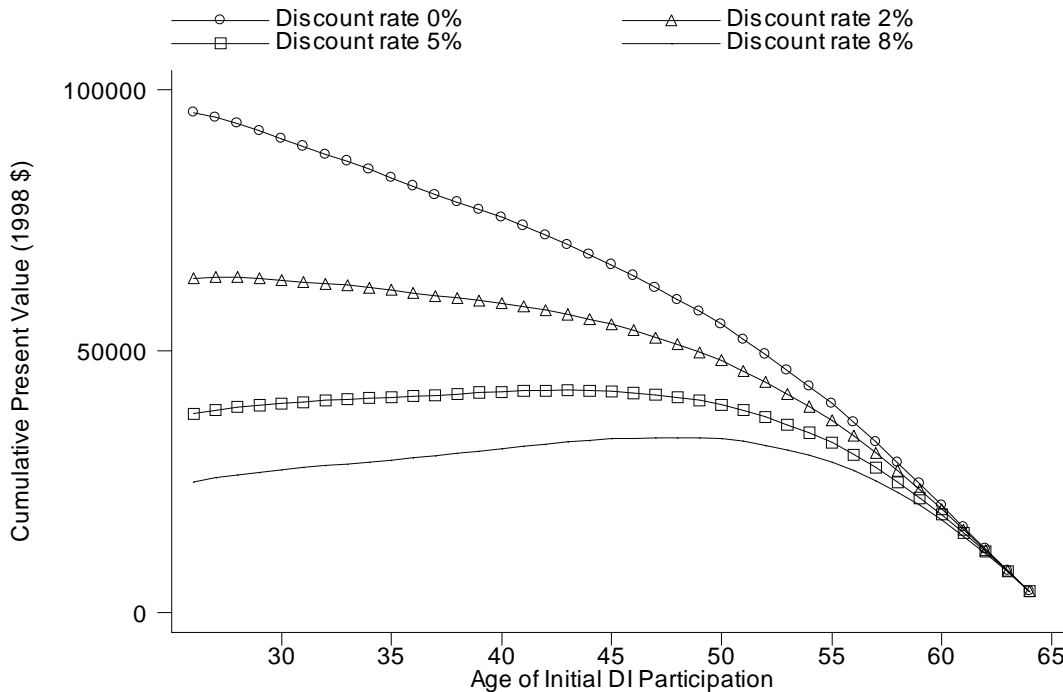


Figure A6: Cumulative Present Value of Medicare Benefits for SSDI Recipients—Mental Retardation

Panel A: Males



Panel B: Females

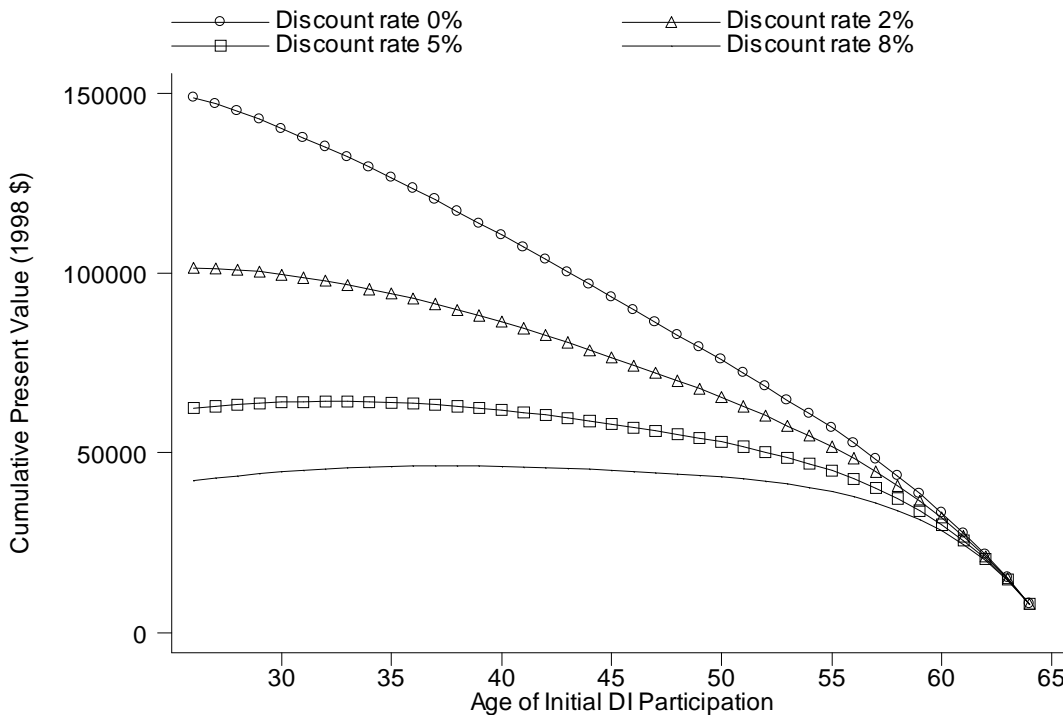


TABLE 3a: INSURANCE CHARACTERISTICS OF DI APPLICANTS AND NON-APPLICANTS (HRS Waves 1-2)*

STATUS AT WAVE 1	MALE					FEMALE				
	DI application by Wave 2	No DI application by Wave 2				DI application by Wave 2	No DI application by Wave 2			
		Whole sample	P> t **	Health limits work	P> t **		Whole sample	P> t **	Health limits work	P> t **
<i>N (unweighted)</i>	67	2471		211		74	2425		180	
Mean age	56.3	55.1	0.001	55.2	0.009	55.5	55.2	0.475	55.7	0.753
% married	69.9%	83.2%	0.035	80.1%	0.145	46.7%	65.7%	0.003	64.9%	0.015
% with health problem that limits work	30.4%	8.3%	0.000	100.0%	0.000	39.5%	7.8%	0.000	100.0%	0.000
Has health insurance through own employer	67.7%	82.5%	0.016	72.3%	0.513	46.7%	61.7%	0.020	58.7%	0.111
<i>Of those with insurance through own employer:</i>										
R (or spouse) pays the whole plan cost	8.9%	6.2%	0.586	6.5%	0.654	9.3%	8.5%	0.884	16.7%	0.283
R (or spouse) pays part of the plan cost	50.5%	57.8%	0.406	53.1%	0.787	58.7%	52.2%	0.494	56.0%	0.799
R's employer or union pays full plan cost	40.6%	36.0%	0.599	40.4%	0.983	32.0%	39.3%	0.420	27.3%	0.650
Has retiree health insurance available through own employer	52.5%	64.3%	0.088	54.4%	0.807	28.2%	41.4%	0.031	35.1%	0.336
<i>Of those whose employer offers retiree health insurance:</i>										
Retirees pay whole plan cost	44.2%	38.3%	0.568	22.0%	0.052	66.3%	43.1%	0.068	35.6%	0.039
Retirees pay part of the plan cost	24.3%	41.5%	0.065	51.7%	0.013	26.5%	35.2%	0.451	28.9%	0.854
Employer or union pays full plan cost	31.4%	20.2%	0.239	26.3%	0.635	7.3%	21.7%	0.045	35.5%	0.007
Has health insurance through spouse's employer	12.2%	12.9%	0.872	14.0%	0.733	18.2%	32.0%	0.003	28.4%	0.085
Has public health insurance coverage	11.4%	7.1%	0.331	10.3%	0.828	4.8%	3.8%	0.733	4.0%	0.790
Has privately purchased health insurance coverage	3.4%	9.9%	0.012	12.7%	0.009	10.0%	13.6%	0.366	11.0%	0.824
Has spouse with health insurance through spouse's employer	29.1%	27.0%	0.738	24.7%	0.526	20.8%	41.1%	0.000	38.9%	0.005
Has spouse with retiree benefits available through spouse's employer	22.1%	16.7%	0.335	14.8%	0.236	16.5%	33.3%	0.000	29.4%	0.030

*SAMPLE: HRS respondents who were working as of Wave 1, who responded to Wave 2, and who had not applied for DI prior to Wave 1

**NOTE: Test is for equality between DI applicants and non-applicants (2-sided)

TABLE 3b: INSURANCE CHARACTERISTICS OF DI APPLICANTS AND NON-APPLICANTS (HRS Waves 2-3)*

STATUS AT WAVE 2	MALE					FEMALE				
	DI application by Wave 3	No DI application by Wave 3				DI application by Wave 3	No DI application by Wave 3			
		Whole sample	P> t **	Health limits work	P> t **		Whole sample	P> t **	Health limits work	P> t **
<i>N (unweighted)</i>	<i>61</i>	<i>2087</i>		<i>205</i>		<i>66</i>	<i>2083</i>		<i>188</i>	
Mean age	56.3	55.1	0.001	55.2	0.009	55.5	55.2	0.475	55.7	0.753
Married	78.3%	83.9%	0.375	81.5%	0.642	40.5%	64.8%	0.000	64.5%	0.002
Working for pay	64.9%	90.1%	0.000	76.8%	0.122	82.9%	87.4%	0.333	69.9%	0.025
Has health problem that limits work	57.8%	9.6%	0.000	100.0%	0.000	44.8%	9.3%	0.000	100.0%	0.000
Has health insurance through own employer	57.2%	78.8%	0.002	71.3%	0.071	46.4%	55.7%	0.180	46.6%	0.984
<i>Of those with insurance through own employer:</i>										
R (or spouse) pays the whole plan cost	4.0%	5.8%	0.537	10.2%	0.161	5.6%	8.9%	0.415	16.9%	0.078
R (or spouse) pays part of the plan cost	42.8%	59.0%	0.107	55.7%	0.253	62.3%	53.1%	0.438	49.7%	0.352
R's employer or union pays full plan cost	53.1%	35.2%	0.077	34.2%	0.093	32.1%	38.0%	0.618	33.4%	0.923
Has retiree health insurance available through own employer	48.8%	59.2%	0.142	55.3%	0.419	35.3%	34.1%	0.859	29.7%	0.452
<i>Of those whose employer offers retiree health insurance:</i>										
Retirees pay whole plan cost	20.9%	39.2%	0.048	40.4%	0.083	38.7%	45.3%	0.661	41.3%	0.877
Retirees pay part of the plan cost	32.1%	42.2%	0.361	40.9%	0.485	37.2%	33.7%	0.820	33.5%	0.830
Employer or union pays full plan cost	47.0%	18.7%	0.018	18.7%	0.031	24.1%	21.0%	0.826	25.2%	0.947
Has health insurance through spouse's employer	10.1%	11.8%	0.658	13.5%	0.453	8.1%	30.4%	0.000	34.8%	0.000
Has public health insurance coverage	14.3%	7.5%	0.176	13.9%	0.940	16.2%	5.4%	0.037	10.9%	0.352
Has privately purchased health insurance coverage	11.3%	10.0%	0.807	12.3%	0.854	8.2%	14.9%	0.074	13.8%	0.216
Has spouse with health insurance through spouse's employer	19.8%	27.7%	0.136	25.5%	0.028	14.7%	42.1%	0.000	40.1%	0.000
Has spouse with retiree benefits available through spouse's employer	9.1%	17.2%	0.027	16.5%	0.011	13.6%	33.9%	0.000	30.9%	0.000

*SAMPLE: HRS respondents who were working as of Wave 1, responded to Wave 2, had not applied for DI prior to Wave 2, and had not reached 63 by Wave 2 or 65 by Wave 3

**NOTE: Test is for equality between DI applicants and non-applicants (2-sided)

TABLE 3c: INSURANCE CHARACTERISTICS OF DI APPLICANTS AND NON-APPLICANTS (HRS Waves 3-4)*

STATUS AT WAVE 3	MALE					FEMALE				
	DI application by Wave 4	No DI application by Wave 4				DI application by Wave 4	No DI application by Wave 4			
		Whole sample	P> t **	Health limits work	P> t **		Whole sample	P> t **	Health limits work	P> t **
<i>N (unweighted)</i>	<i>40</i>	<i>1594</i>		<i>179</i>		<i>46</i>	<i>1612</i>		<i>170</i>	
Mean age	58.0	57.9	0.798	58.0	0.858	58.3	58.1	0.450	58.0	0.413
Married	79.5%	83.1%	0.558	82.3%	0.684	48.6%	63.2%	0.074	66.2%	0.050
Working for pay	67.9%	86.3%	0.018	72.5%	0.592	63.1%	80.9%	0.029	56.9%	0.495
Has health problem that limits work	45.7%	11.5%	0.000	100.0%	0.000	44.2%	10.7%	0.000	100.0%	0.000
Has health insurance through own employer	64.2%	79.4%	0.055	64.3%	0.986	66.3%	60.6%	0.467	47.5%	0.034
<i>Of those with insurance through own employer:</i>										
R (or spouse) pays the whole plan cost	17.2%	5.9%	0.172	4.6%	0.138	6.8%	8.1%	0.747	18.6%	0.052
R (or spouse) pays part of the plan cost	54.2%	60.6%	0.555	61.5%	0.536	66.8%	55.7%	0.256	47.8%	0.095
R's employer or union pays full plan cost	28.6%	33.5%	0.596	33.9%	0.610	26.4%	36.2%	0.299	33.6%	0.507
Has retiree health insurance available through own employer	45.6%	50.7%	0.571	40.9%	0.632	27.3%	34.7%	0.337	25.5%	0.826
Has health insurance through spouse's employer	11.0%	12.1%	0.827	10.5%	0.936	18.8%	26.5%	0.265	30.9%	0.121
Has public health insurance coverage	8.4%	6.1%	0.601	11.9%	0.481	10.5%	4.3%	0.235	7.5%	0.585
Has privately purchased health insurance coverage	6.4%	4.7%	0.679	7.5%	0.806	0.0%	8.6%	0.000	7.5%	0.001
Has spouse with health insurance through spouse's employer	20.7%	22.9%	0.745	22.7%	0.794	20.0%	39.0%	0.007	45.3%	0.002
Has spouse with retiree benefits available through spouse's employer	15.6%	14.3%	0.820	9.3%	0.310	7.3%	31.6%	0.000	35.6%	0.000

*SAMPLE: HRS respondents who were working as of Wave 1, responded to Waves 2 and 3, had not applied for DI prior to Wave 3, and had not reached 63 by Wave 2 or 65 by Wave 3

**NOTE: Test is for equality between DI applicants and non-applicants (2-sided)

TABLE 4a: HEALTH CHARACTERISTICS OF DI APPLICANTS AND NON-APPLICANTS (HRS Waves 1-2)*

STATUS AT WAVE 1	MALE					FEMALE				
	DI application by Wave 2	No DI application by Wave 2				DI application by Wave 2	No DI application by Wave 2			
		Whole sample	P> t **	Health limits work	P> t **		Whole sample	P> t **	Health limits work	P> t **
<i>N (unweighted)</i>	<i>67</i>	<i>2471</i>		<i>211</i>		<i>74</i>	<i>2425</i>		<i>180</i>	
Ever had high blood pressure	34.6%	32.0%	0.673	39.6%	0.486	49.6%	29.2%	0.002	34.7%	0.046
Ever had diabetes	19.1%	7.1%	0.020	15.3%	0.514	18.6%	5.7%	0.007	8.4%	0.052
Ever had cancer	4.1%	2.1%	0.469	2.2%	0.525	2.7%	6.7%	0.016	9.7%	0.012
Ever had lung disease	12.2%	3.7%	0.054	9.9%	0.643	16.9%	3.8%	0.007	7.2%	0.067
Ever had heart problems	22.5%	10.3%	0.026	29.3%	0.297	14.3%	0.9%	0.058	15.7%	0.804
Ever had stroke	3.7%	1.5%	0.363	4.6%	0.726	4.8%	0.9%	0.128	2.6%	0.445
Ever had psychiatric problems	5.0%	3.4%	0.609	10.2%	0.181	17.1%	5.2%	0.014	11.2%	0.276
Ever had arthritis	37.9%	25.5%	0.059	43.6%	0.450	59.4%	35.5%	0.000	58.3%	0.880

*SAMPLE: HRS respondents who were working as of Wave 1, who responded to Wave 2, and who had not applied for DI prior to Wave 1

**NOTE: Test is for equality between DI applicants and non-applicants (2-sided)

TABLE 4b: HEALTH CHARACTERISTICS OF DI APPLICANTS AND NON-APPLICANTS (HRS Waves 2-3)*

STATUS AT WAVE 2	MALE					FEMALE				
	DI application by Wave 3	No DI application by Wave 3				DI application by Wave 3	No DI application by Wave 3			
		Whole sample	P> t **	Health limits work	P> t **		Whole sample	P> t **	Health limits work	P> t **
<i>N (unweighted)</i>	<i>61</i>	<i>2087</i>		<i>205</i>		<i>66</i>	<i>2083</i>		<i>188</i>	
Ever had high blood pressure	42.0%	33.9%	0.243	44.3%	0.773	49.9%	31.9%	0.009	46.7%	0.684
Ever had diabetes	18.8%	7.7%	0.056	15.7%	0.630	23.6%	6.0%	0.001	12.5%	0.065
Ever had cancer	5.9%	3.1%	0.444	3.3%	0.507	8.7%	7.8%	0.795	11.8%	0.453
Ever had lung disease	7.6%	4.6%	0.441	10.7%	0.477	12.2%	4.6%	0.073	11.4%	0.877
Ever had heart problems	23.3%	11.5%	0.045	25.4%	0.754	13.0%	6.5%	0.118	14.2%	0.816
Ever had stroke	7.0%	1.8%	0.143	6.1%	0.829	5.2%	0.9%	0.119	1.1%	0.155
Ever had psychiatric problems	14.6%	4.3%	0.054	11.5%	0.588	14.8%	6.4%	0.049	16.9%	0.679
Ever had arthritis	47.4%	29.4%	0.010	45.5%	0.801	76.9%	40.8%	0.000	61.8%	0.026

*SAMPLE: HRS respondents who were working as of Wave 1, responded to Wave 2, had not applied for DI prior to Wave 2, and who had not reached 63 by Wave 2 or 65 by Wave 3

**NOTE: Test is for equality between DI applicants and non-applicants (2-sided)

TABLE 4c: HEALTH CHARACTERISTICS OF DI APPLICANTS AND NON-APPLICANTS (HRS Waves 3-4)*

STATUS AT WAVE 2	MALE					FEMALE				
	DI application by Wave 4	No DI application by Wave 4				DI application by Wave 4	No DI application by Wave 4			
		Whole sample	P> t **	Health limits work	P> t **		Whole sample	P> t **	Health limits work	P> t **
<i>N (unweighted)</i>	<i>40</i>	<i>1594</i>		<i>179</i>		<i>46</i>	<i>1612</i>		<i>170</i>	
Ever had high blood pressure	45.1%	36.4%	0.300	45.6%	0.949	51.8%	33.5%	0.024	45.6%	0.487
Ever had diabetes	10.4%	8.6%	0.738	18.1%	0.200	14.3%	7.0%	0.216	15.6%	0.840
Ever had cancer	6.8%	3.3%	0.462	4.7%	0.679	14.9%	8.2%	0.255	8.9%	0.342
Ever had lung disease	15.7%	4.5%	0.066	9.0%	0.300	2.5%	5.3%	0.262	9.3%	0.046
Ever had heart problems	21.5%	12.8%	0.210	30.7%	0.236	10.8%	7.3%	0.487	15.6%	0.404
Ever had stroke	6.0%	2.3%	0.365	5.1%	0.846	5.9%	1.0%	0.232	2.5%	0.433
Ever had psychiatric problems	9.1%	4.8%	0.363	14.6%	0.318	18.4%	7.5%	0.085	20.9%	0.717
Ever had arthritis	56.3%	34.8%	0.010	50.7%	0.541	61.3%	44.7%	0.036	76.5%	0.080

*SAMPLE: HRS respondents who were working as of Wave 1, responded to Waves 2 and 3, had not applied for DI prior to Wave 3, and had not reached 63 by Wave 2 or 65 by Wave 3

**NOTE: Test is for equality between DI applicants and non-applicants (2-sided)