How Policy Variables Influence the Timing of Applications for Social Security Disability Insurance

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The onset of a work-limiting health condition may lead workers to reevaluate their lifetime work path. This article analyzes the impact of policy variables—employer accommodations, state Social Security Disability Insurance (DI) acceptance rates, and DI benefits—on the timing of DI applications for such workers.

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Summary

This article analyzes the impact of policy variables—employer accommodations, state Social Security Disability Insurance (DI) allowance rates, and DI benefits—on the timing of an application for DI benefits by workers with a work-limiting health condition starting when their health condition first begins to bother them. The analysis uses a rich mixture of personal and employer characteristics from the Health and Retirement Study linked to Social Security administrative records.

We find that most workers do not apply immediately for DI benefits when they are first bothered by a health condition. On the contrary, the median working-age man with a work-limiting condition waits 7 years after that time before applying, and the median working-age woman waits 8 years. Although the risk of applying for benefits is greatest in the year following onset, only 16 percent of men and 13 percent of women in our sample apply within the first year, and the risk of application falls thereafter. That finding suggests that institutional factors, in addition to health factors, may play a role in the timing of DI applications.

Using kernel density estimates of the distribution of application and nonapplication ordered by state allowance rates (the rate of acceptance per DI determination in each state), we find that both men and women who live in states with high allowance rates are disproportionately more likely to apply for benefits in the first year after their condition begins to bother them than are those in states with low allowance rates. Using life-table analysis, we also find that men and women who are accommodated by their employers are significantly less likely to apply for DI benefits in each of the first few years after their condition begins to bother them than are those who are not accommodated.

On the basis of this evidence, we include these policy variables in a model of the timing of DI application that controls for other socioeconomic variables as well as health. Using a hazard model, we find that workers who live in states with higher allowance rates apply for DI benefits significantly sooner than those living in states with lower allowance rates following the onset of a work-limiting health condition. Workers who are accommodated following the onset of a work-limiting health condition, however, are significantly slower to apply for DI benefits.

Using the mean values of all explanatory variables, we estimate the relative importance of changes in these policy variables on the speed with which workers apply for benefits after onset. We find that the mean time until application for men is 10.22 years. Universal accommodations following onset would delay application by 4.36 years. In contrast, a 20 percent decrease in state allowance rates would delay application by only 0.88 years. For working-age women, the average expected time until application once a condition begins to bother them is 10.58 years. Universal accommodations would delay that by 3.76 years, and a 20 percent decrease in allowance rates would delay it by 1.47 years.

A complication in this analysis is that the policy variables are to some degree endogenous. Accommodation is probably offered more often to workers who want to continue working. Allowance rates are chosen by states on the basis of federal policy and local choices and probably in part on the health condition of workers in the state. Therefore, our estimates are upper bounds of these policy effects. Still, we believe we provide evidence that the social environment faced by workers with work-limiting health conditions can significantly influence their decision to apply for DI benefits, holding their specific health conditions constant.

Introduction

Social Security Disability Insurance (DI) is the largest federal transfer program targeted toward workers with work-limiting health conditions. It dominates all other government programs aimed at that population. It replaces the earnings of workers who, because of a health condition, are no longer able to perform any substantial gainful activity. Like all transfer programs triggered by lost earnings, DI may discourage work.

U.S. public policy toward people with work-limiting health conditions took a major turn in the 1990s with the passage of the Americans with Disabilities Act of 1990 (ADA), the centerpiece of government policy focused on keeping people with work-limiting health conditions in the workforce. Title I of the ADA requires employers to make reasonable accommodations for workers with disabilities unless that would cause undue hardship to the operation of business. One of the hopes underlying the ADA is that accommodation will delay job exit and a subsequent move to apply for DI benefits. Yet even a decade after the passage of the ADA, little systematic evidence exists about the labor force experience of people with work-limiting health conditions and how they and their employers respond when a health condition begins to affect work.

These two policy thrusts—DI transfers to replace lost earnings and accommodation to increase duration on the job—can send mixed signals to workers. Although the onset of a health condition may affect a worker's ability to remain on the job, it does not necessarily result in a swift and certain job exit and transition from work to application for DI benefits. The decision to leave the workforce and apply for DI benefits can be influenced both positively and negatively by policy variables. Hence, understanding how such policies influence behavior for those who experience a work-limiting health condition is critical in developing policies that fully integrate people with disabilities into the workforce.

We estimate the relative importance of policy variables—employer accommodation as well as the relative value and likelihood of acceptance into the DI program—on the timing of application for DI benefits by workers with work-limiting health conditions, starting at the point a health condition first begins to bother them.[1] Our analysis uses retrospective data from the Health and Retirement Study (HRS) together with matching state-level data on DI allowance rates and individual-level data from Social Security administrative records on the generosity of DI benefits. The results show that employer accommodation significantly slows a worker's application for DI benefits and that easier access to DI benefits and more generous DI benefits hastens application.

Background

Burkhauser, Butler, Kim, and Weathers (1999) provide empirical evidence of the impact of policy variables on the decision to apply for DI benefits.[2] They show that most male workers with work-limiting health conditions do not apply for DI benefits immediately after their health condition begins to bother them. Rather, the timing of their application is affected by a number of variables, including the policy environment, their health characteristics, and their socioeconomic situation. In this article, we extend that analysis by including a variable that captures the impact of state administration of the DI program. We also add a variable based on research by Kreider (1998, 1999b) to measure the variance of wages and expand our analysis to examine the decision of women to apply for DI benefits.[3] We use life tables and hazard models to estimate the influence of socioeconomic and health factors on the timing of DI application.

Although our hazard model provides evidence of the influence of policy variables on the timing of DI application, those findings must be put into context. Below we examine each of the policy variables estimated in the

article and discuss the factors to be considered in interpreting the findings.

State Allowance Rate

Although DI is a federal program with uniform eligibility rules, all initial eligibility determinations are made at the state level. We use the annual state allowance rate, defined as the proportion of applicants awarded benefits in the initial five-step determination, as a measure of administrative decisionmaking at the state level. (See Appendix Tables B-1 and B-2 for state allowance rates between 1974 and 1993.) Allowance rates vary greatly across states and over time, and we use that variation to identify the impact of administrative decisionmaking, or ease of program access, on application behavior. Note that variation between states can be based in part on different average levels of health, making approval rates endogenous to application. However, variation over time is more likely to be based on administrative and judicial policy.

Using standard ANOVA calculations, we determine that the proportion of variance in state allowance rates across time is 50 percent from 1974 to 1980, 21 percent from 1980 to 1993, and 42 percent over the entire 1974-1993 period. We also find that the variance in state allowance rates within states and across time, which belongs to neither uniquely, is 18 percent over the entire period. Thus, there is a substantial amount of variance in this explanatory variable.

Muller and Wheeler (1998) provide qualitative support for the use of state allowance rates as a measure of variation in the state administrative decision process.[4] In March 1994, they surveyed the 1,300 managers of Social Security Administration (SSA) field offices, asking open-ended questions about the factors that affected program growth between 1989 and 1993. Although the authors did not ask direct questions about allowance rates, a substantial number of managers stated in the open-ended questions that easier standards and higher allowance rates increased applications.

Two confounding factors may affect the measure of the state allowance rates. First, persons may choose the state allowance rate by moving to a different state to apply for DI benefits. We believe that such behavior would be costly to the applicant, and there is no systematic evidence that it occurs in practice, nor is such behavior observed in the data.[5] To the degree that this behavior occurs, we understate the importance of the state allowance rate on the timing of DI application. Second, part of the differences in state allowance rates may be due to differences among states in the underlying composition of health and economic conditions. The model attempts to minimize that effect by including a set of control variables for individual health and state economic conditions. Nevertheless, the possibility of this type of endogeneity exists.

Size of Benefits

Workers approved to receive DI benefits are entitled to a monthly benefit called the primary insurance amount (PIA). The PIA is based on the worker's Social Security earnings history. Previous research has used the replacement rate—defined as the proportion of a person's monthly earnings that is replaced by DI benefits—as a measure of the importance of DI benefits. The replacement rate is progressive—that is, workers with lower earnings histories tend to have more of their monthly earnings replaced by the PIA. Because lower earners are both more likely to have higher replacement rates and more likely to apply for benefits for other reasons (for example, less pleasant work and lower benefits), the replacement rate measure may overstate the causal impact of DI benefits on the decision to apply. Alternative approaches to measuring the impact of DI benefits have also been criticized on the basis of weak identification strategies (Bound and Burkhauser 1999).

We use the approach of Burkhauser, Butler, Kim, and Weathers (1999) to estimate the impact of DI benefits in this article. We use a restricted data file that contains Social Security earnings history data for HRS respondents along with Social Security information on program rules to compute an expected PIA for each person for every year from the year in which a health condition first began to bother the respondent to the year of application. We then estimate expected yearly labor earnings on the basis of past labor earnings and enter the expected PIA (per year) and expected yearly labor earnings separately in the model.[6] That approach identifies the coefficient on the potential benefit variable on the basis of nonlinearities in the benefit structure rather than on the replacement rate. Although we believe this identification strategy improves on the approaches used in the literature, expected PIA can be endogenous and the estimate is an upper bound.

Employer Accommodation

Burkhauser, Butler, Kim, and Weathers (1999) focus on the impact of employer accommodation on the decision of male workers to apply for DI. We extend our analysis of employer accommodation in two ways. First, we examine the impact of employer accommodation on a sample of both men and women. Second, we present life-table estimates that show the risk of DI application, given that application has not already occurred, for workers who receive employer accommodation and then compare it with the risk for workers who have not received accommodation. The estimates are presented separately for men and women.

In our model, we define employer accommodation using the following survey question: "At the time your health started to limit your ability to work, did your employer do anything special to help you out so that you could stay at work?" Employers are more likely to invest in accommodation for employees who will remain at work for a longer period of time and hence are less likely to apply for DI benefits. The empirical estimates based on this survey question are also upper bounds of the impact of employer accommodation on the timing of DI application.[7]

The Empirical Specification: A Hazard Model

We use a variant of the Diamond and Hausman (1984) hazard model. The respondents' hazard rates are defined as the probability of applying for DI benefits from the point at which work-limiting health conditions first began to bother them.

We know the year the condition first began to bother each respondent, so left-censoring is not a problem (that is, we are able to observe all cases from the initial time of onset). However, many workers in the sample have not applied for benefits by 1992, the last year of our data, and they are right-censored (that is, we cannot observe all cases until they apply for DI benefits). The hazard model explicitly accounts for right-censored observations. We use a hazard model that controls for unobserved heterogeneity to estimate the impact of policy on the transition to DI application. We integrate unobserved heterogeneity out of the likelihood function by assuming a lognormal form. Equation 1 describes the hazard function for person *j* in the sample:

$$h_j(t_j) = \exp(X'_j \beta + t_j \gamma_1 + t_j^2 \gamma_2 + \varepsilon), \quad (1)$$

where X_j is the vector of policy variables along with other explanatory variables for person *j*; β is the vector of coefficients for the explanatory variables; t_j is time; γ_1 and γ_2 are the coefficients on time and time squared respectively; and ε is unmeasured heterogeneity, which is assumed to be distributed lognormal. Using this hazard function specification, equation 2 describes the resulting likelihood function *f* for person *j* who applies for DI at time t_j.

$$f_j = h_j(t_j) \exp\left(-\int_0^{t_j} h_j(s)\, ds\right). \quad (2)$$

Equation 3 describes the resulting likelihood function *f* for person *j* who is right-censored:

$$f_j = h_j(t_j) \exp\left(-\int_0^{t_j} h_j(s)\, ds\right). \quad (3)$$

We use an interval hazard because we cannot observe the exact time of DI application. We only know that application occurred sometime during a given year. Equation 4 describes the situation in which an application occurs at t_j but is only captured as occurring between t_s and t_e, a 1-year interval.

$$f_j = \int_{t_s}^{t_e} h_j(v) \exp\left(-\int_0^{v} h_j(s) ds\right) dv. \quad (4)$$

Data

The Health and Retirement Study is a longitudinal data set that tracks the behavior and economic well-being of a representative cohort of men and women born between 1931 and 1941 and their spouses through their retirement years. Four waves of data are now available. In 1992 (wave 1), a total of 12,654 men and women from 7,607 households were asked detailed questions regarding their labor force participation, health status, family structure, work-limiting health conditions, wealth holdings, and income. Those data were then matched to restricted Social Security administrative records that contain a respondent's Social Security earnings history.

Although the data set is large, the onset of a work-limiting health condition is a relatively rare event even at these ages—51 to 61 in 1992. Therefore, even with four waves of data it is difficult to make full use of the longitudinal nature of the data by contemporaneously looking at work behavior following the onset of a work-limiting health condition. However, the HRS has a retrospective module that contains a series of questions focused on events following the onset of a current work-limiting health condition. We use those data here.

In the first wave of the HRS, 1,280 men and 1,338 women reported having an impairment or health problem that limited the kind or amount of paid work they could perform and that they expected to last for at least 3 months. Of that group, 848 men and 642 women said they were working for someone else (not self-employed) at the onset of their work-limiting health condition. Of those respondents, we use 577 men and 472 women in our analysis. Most of the final round of respondents were excluded because their work-limiting health conditions began to bother them before 1974, the first year for which we have information on state allowance rates.

Variables

The analysis uses a set of variables relating to spell length, policy, economic status, health status, and demographic characteristics. The variables are described in Table 1.

Table 1.
Description of variables used in the analysis

Variable	Description
	Spell length
Work-limiting health condition	A health condition or impairment that limits the kind or amount of paid work that can be performed. The health condition or impairment is expected to last at least 3 months.
—(Bother)	The year the disability first began to bother the person.
—(Interfere)	The year the work-limiting health condition first began to interfere with the person's work.
Apply	Value equals 1 if the person applied for DI benefits; 0 otherwise.
Censor	Value equals 1 if the person had not applied for benefits; 0 otherwise.
Condition bother duration	The year of first application for DI minus the year the work-limiting health condition first began to bother the person.
Condition limit duration	The year of first application for DI minus the year the work-limiting health condition first began to interfere with the person's work.
	Policy
State allowance rate	Persons who are awarded DI benefits divided by the number of DI determinations in each state and for each year from 1974 through 1993.
Expected DI benefit amount	Primary insurance amount multiplied by 12.
Employer accommodation	Value equals 1 if the employer did anything special to help the person out so that the person could stay at work; 0 otherwise.
	Economic
Expected earnings	Annual measure of expected labor earnings in the years following the application decision year.
State unemployment rate	Unemployment rate for each state and for each year from 1974 through 1993.
Spouse works at onset	Value equals 1 if the spouse was working at onset; 0 otherwise.
Savings at onset	Value equals 1 if the person had savings at onset; 0 otherwise.
Experience	The person's number of quarters of Social Security coverage at onset.
Tenure missing	Value equals 1 if the person did not have information on tenure; 0 otherwise.
Tenure	Years of work with employer at the onset of a work-limiting health condition.
Job requirements	Value equals 1 if the job required one of the requirements listed below; 0 otherwise. Requirements included: A lot of physical effort; lifting heavy objects; stooping, kneeling or crouching; good eyesight; intense concentration; keeping up with a pace set by others; and skill dealing with people. The first three categories mentioned are joined to form a composite measure, and good eyesight and intense concentration are joined to form another measure.
All of the time	Value equals 1 for each of the job requirements if required all of the time; 0 assigned for most, some, or none of the time.
Most of the time	Value equals 1 for each of the job requirements if required all of the time or most of the time; 0 assigned for some or none of the time.
Occupation	Value equals 1 for each of the set of occupations at onset; 0 otherwise. Occupations include: Manager; Professional; Sales; Clerical; Service; Craftsperson; Laborer; Military; miscellaneous; occupation missing.

Continued

Table 1.
Continued

Variable	Description
White collar	Value equals 1 if person's occupation is Manager or Professional; 0 otherwise.
Industry	Value equals 1 for each of the set of industries at onset; 0 otherwise.
	Industries include: Agriculture; Mining; Manufacturing; Transportation; Retail, Wholesale, Finance; Service; Professional Service; Public Administration; industry missing.
Employer size	Value equals 1 for the set of employer size values at onset; 0 otherwise.
	Employer sizes include: less than 5 employees; 5–14 employees; 15-24 employees; 25-99 employees; 100–499 employees; 500 or more employees; number of employees missing.
Decide pay	Value equals 1 if the person decides the pay of other employees; 0 otherwise.
Pension	Value equals 1 if the person has a pension plan with the onset employer; 0 otherwise.
Pension missing	Value equals 1 if pension information is missing; 0 otherwise.
Union	Value equals 1 if the person is a member of a union at onset; 0 otherwise.
Union missing	Value equals 1 if union information is missing; 0 otherwise.
Work-limiting health condition caused by work	Value equals 1 if the work-limiting health condition was in any way caused by the nature of the person's work; 0 otherwise.
Work-limiting health condition a result of accident at work	Value equals 1 if the work-limiting health condition was a result of an accident that occurred at work; 0 otherwise.
Veteran	Value equals 1 if the person served in the military; 0 otherwise.
	Health [a]
Two conditions	Value equals 1 if person has two health conditions at onset; 0 otherwise.
Three conditions	Value equals 1 if person has three or more health conditions at onset; 0 otherwise.
First mention	Value equals 1 if the health condition used was based on the first condition mentioned by the respondent; 0 otherwise.
Any mention	Value equals 1 if the health condition used was based on all possible reports; 0 otherwise.
Cancer	Value equals 1 if the condition was in one of the following categories; 0 otherwise. • Cancer; leukemia; Hodgkin's disease; melanomas; malignant tumors. • Other tumors, cysts, or growths; "polyps." • Skin conditions; dermatitis; eczema; "rashes"; Paget's disease.
Musculoskeletal	Value equals 1 if the condition was in one of the following categories; 0 otherwise. • Arthritis; rheumatism; bursitis. • Back/neck/spine problems; chronic stiffness, deformity, or pain; disc problems; scoliosis; spinal bifida; "bad back." • Stiffness, deformity, numbness, or chronic pain in foot, leg, arm, or hand; "bad knee"; hip problems; hip replacement. • Hernias; hiatal hernia. • Muscular dystrophy. • Other musculoskeletal or connective tissue problems; lupus; osteoporosis; pinched nerve; carpal tunnel syndrome; fibrositis.

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Table 1.
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Variable	Description
Paralysis	Value equals 1 if the condition was in one of the following categories; 0 otherwise. • Missing legs, feet, arms, hands, or fingers. • Paralysis—any mention, including from polio.
Cardiovascular	Value equals 1 if the condition was in one of the following categories; 0 otherwise. • Heart problems: heart attack (coronary) or failure; arteriosclerosis; aneurysms; heart deformities; angina; "bad heart"; congestive heart disease. • High blood pressure (hypertension). • Stroke; cerebral hemorrhage or accident. • Blood disorders: anemia; hemophilia; polycythemia; "bad blood"; toxemia. • Other circulatory problems; phlebitis, clots, embolisms; varicose veins; hemorrhoids; low blood pressure.
Respiratory	Value equals 1 if the condition was in one of the following categories; 0 otherwise. • Allergies; hay fever; sinusitis; tonsillitis. • Asthma. • Bronchitis; pneumonia; "acute upper respiratory problems." • Emphysema. • Other respiratory problems; tuberculosis.
Endocrine	Value equals 1 if the condition was in one of the following categories; 0 otherwise. • Diabetes. • Thyroid trouble; goiter. • Cystic fibrosis. • Nutritional problems; weight problems; eating disorders; high cholesterol. • Other endocrine/metabolic problems; pancreatitis; pituitary problems; Addison's
Digestive	Value equals 1 if the condition was in one of the following categories; 0 otherwise. • Stomach and intestinal conditions: ulcers; colitis; gastritis; diverticulosis; appendicitis; Crohn's disease; "stomach pains." • Liver conditions: cirrhosis; hepatitis. • Kidney conditions: kidney stones; kidney failure (including dialysis). • Gallbladder conditions. • Bladder conditions; urinary infections. • Urinary incontinence; urinary loss/leakage; problems with bladder control. • Other digestive system problems.
Neurological	Value equals 1 if the condition was in one of the following categories; 0 otherwise. • Blindness or vision problems: glaucoma; cataracts; detached retina. • Deafness, hearing loss, or other ear conditions. • Multiple sclerosis; cerebral palsy; epilepsy; Parkinson's; ALS; "seizures"; neuropathy. • Speech conditions—any mention: congenital speech defects; stuttering. • Mental retardation; learning disabilities; Down's syndrome. • Other neurological/sensory problems; sciatica; "headaches"; "dizziness"; "blackouts"; "brain damage"; meningitis; "memory loss."
Reproductive	Value equals 1 if the condition was in one of the following categories; 0 otherwise. • Pregnancy and childbirth problems; miscarriage; stillbirth; Rh factor. • Infertility; sterilization; vasectomy; tubal ligation. • Prostate conditions. • Other problems of reproductive system; hysterectomy; ovarian problems; PMS; menopause.

Continued

Table 1.
Continued

Variable	Description
Emotional	Value equals 1 if the condition was in one of the following categories; 0 otherwise. • Alcoholism. • Drug abuse, addiction. • Other severe psychological conditions: (chronic) depression; schizophrenia; mania; paranoia; autism; psychosis. • Other emotional and psychological problems; "mental problems"; "nerves"; "nervous breakdown."
Miscellaneous	Value equals 1 if the condition was in one of the following categories; 0 otherwise. • Alzheimer's disease; "senility." • Dental and gum conditions—any mention. • Acute infectious diseases; flu, colds, fever, mumps, etc. • Injuries and traumas: broken bones; pulled muscles; strains; tendon damage; burns, lacerations; concussion; side effects/conditions due to surgery. • Sleep disorders; sleep apnea; narcolepsy. • Immune system disorders; HIV positive; AIDS; ARC. • Old age; "everything wore out." • Lack of energy/strength; (chronic) fatigue—not elsewhere classified. • Other health condition.
	Demographic
Education	Years of education attained.
Age	Age at onset.
Married at onset	Value equals 1 if married at onset; 0 otherwise.
White	Value equals 1 if race is white; 0 otherwise.
Black	Value equals 1 if race is black; 0 otherwise.
Other	Value equals 1 if race is not black or white; 0 otherwise.

NOTES: A data appendix that contains further information regarding these variables is available upon request. To obtain a copy, send an email to Robert.R.Weathers@ssa.gov.

a. Bullets signify that the health conditions were included within the same condition in the HRS.

Spell Length

Every person in our sample reported having a long-term work-limiting health condition in 1992. They were asked when that condition first began to bother them and when it first began to interfere with their work. We use the year in which the work-limiting condition first began to bother them to mark the onset of our analysis. Using the alternative definition (interfering with work) made no practical difference in our estimates.[8]

The timing of the person's first application for DI was identified using the following HRS questions:

- J123. Have you ever applied for disability from the Social Security Disability Insurance (DI) program or the Supplemental Security Income (SSI) program?
- J123a. In what month and year did you first apply?

These questions present the problem of separating DI applications from SSI applications. Fortunately, we are able to identify eligibility for DI benefits in any given year using the restricted HRS file, which contains records of Social Security earnings and work histories for respondents from 1951 through 1991. The analysis includes persons who, based on their Social Security work history and DI program rules, were eligible for DI benefits at the time their work-limiting health condition began to bother them.[9] For persons who applied for DI benefits, time to application is defined as the number of years from the time their condition first bothered them to the time of first application. For those who had not applied by the date of the HRS interview, application for benefits is not observed and time to application is censored. Time to the censored transition is defined as years from the onset of a work-limiting health condition to the HRS wave 1 interview in 1992.

Policy Variables

State Allowance Rate. We define the state allowance rate as the number of DI allowances made within the five-step state eligibility determination process divided by the number of DI determinations in the state for the given year.[10] We use the HRS restricted data on geographic location to match yearly DI allowance rates to each person in the sample.[11] The state allowance rate is a time-varying variable in the model. A higher allowance rate is expected to increase the hazard of DI application.

Expected Benefits. We construct each worker's potential yearly DI benefit from the restricted-use Social Security Administration records that contain respondents' Social Security earnings histories. To do so, we use program rules from 1974 through 1993 to calculate the expected monthly primary insurance amount for each year in our analysis and then annualized that value and used it as a time-varying variable in the model.[12] We expect higher values to increase the hazard of DI application.[13]

Employer Accommodation. Employer accommodation is based on a question to the respondent asking if the employer did anything special for the respondent when the work limitation began. We expect employer accommodation to reduce the hazard of DI application.

Economic Variables

The loss of expected earnings in the period following application is the opportunity cost of applying for DI benefits. The greater a worker's potential labor market earnings, the more expensive is DI application. Burkhauser, Butler, Kim, and Weathers (1999) found that higher expected earnings delayed DI application for men. We use an approach similar to theirs to measure expected labor earnings, which is a time-varying variable, in this analysis.[14]

Kreider (1998, 1999a, 1999b) pointed out the importance of controlling not only for the expected labor earnings but also for the variance of labor earnings. If labor earnings generally grow and are approximately lognormal in distribution, the two measures are highly correlated; in the present data set, the average correlation within a given year is 94.3 percent, and the difference is uncorrelated with other variables. Other things being equal, a worker whose labor earnings are variable is less likely to apply for DI benefits. In this analysis, we follow Kreider and include a measure of variance for each person in our sample.

We use the state unemployment rate to capture effects of the business cycle that influence a worker's decision to apply for DI.[15] The data vary over time in the model. A higher unemployment rate is expected to reduce the time to DI application. During a recession, one might expect that layoffs and poor job opportunities would lead to quicker application for DI benefits.[16] In addition, controlling for the unemployment rate reduces the possibility that our state allowance rate variable is endogenous. That reduces, but does not eliminate, concern about our estimated impacts being biased upward.[17]

Other economic variables included in our hazard model to control for individual heterogeneity include spouse's work status, savings, industry, occupation, employer size, and union status.

Health Variables

By definition, all the people in our sample have a work-limiting health condition in 1992. The health variables control for variations in health status within that population. Our first comorbidity variable measures the impact that two health conditions have on application. The second measures the impact of three or more health conditions.

Two factors associated with these measures should affect the timing of DI application. First, multiple health conditions may make adapting to a work limitation more difficult and increase the speed of application. Second, the 1984 Amendments to the Social Security Act require SSA to look at the combined effect of all impairments regardless of whether any one impairment, considered separately, would be deemed severe enough for acceptance into the DI program. Multiple conditions may increase both a worker's probability of receiving a benefit and the adaptations necessary to remain in the labor force and thus hasten DI application.

Some health conditions are likely to lead to more rapid application than others. Musculoskeletal conditions, such as arthritis and back, neck, and spine problems, tend to be chronic and hence are likely to lead to a relatively longer duration until the worker applies for DI benefits. Cardiovascular conditions, such as strokes and heart attacks, tend to be acute and lead to shorter duration to DI application. Table 1 lists the diagnosed conditions included in each of those categories.

We examine the importance of other types of health conditions on the application decision in additional specifications. The additional conditions include cancer, paralysis, respiratory conditions, endocrine and digestive conditions, neurological conditions, reproductive conditions, emotional conditions, and others. Table 1 also shows the specific diagnosed conditions in each category.

Demographic Variables

Education, age, marital status, and race are included to capture differences in labor market attachment across demographic groups. Most studies of labor supply find that those variables influence labor supply.

Descriptive statistics for the variables in the models are presented in Table 2.[18]

The Timing of Application for DI Benefits: Evidence from Life Tables

Table 3 contains life tables that describe the spell lengths and hazard of DI applications for our sample. The table shows, for men and women, the number of years since the onset of a work-limiting health condition, the probability of surviving to the beginning of the year, the number who apply within the year, the number who are censored within the year, and the hazard rate.

The estimated survival rates show that the median man waits 7 years after his work-limiting condition first begins to bother him before he applies for DI benefits. The median woman waits 8 years. Although the risk of application is greatest in the first year, only 16 percent of men and 13 percent of women apply in the first year, and the hazard rate declines thereafter.[19]

Ease of Access to DI Benefits: Kernel Density Estimates

Chart 1 shows nonparametric kernel density estimates of the distributions of male applicants and nonapplicants ordered by state DI allowance rates.[20] The top panel of Chart 1 shows the two distributions for the first year following the year a work-limiting health condition first begins to bother them, ordered by the state allowance rates in that year. The bottom panel of Chart 1 is more complex. Workers who do not apply for benefits in the first period continue to contribute observations to the sample until they do apply or are censored. Each person may be included up to 10 times. Hence, these distributions contain observations for men who do or do not apply for benefits, ordered by the state DI allowance rates for each year, for up to 10 years following the onset of a work-limiting health condition. Chart 2 contains the same set of distributions for women.

The horizontal axis of the charts measures the state allowance rates. The vertical axis measures the estimated density of all sample members (for all relevant years) at each state allowance rate. One line shows the kernel density estimates for workers who do not apply for DI benefits within the period; the other line shows the kernel density estimates for workers who do apply for DI benefits.

The two distributions cross at an allowance rate of about 39 percent for men and about 35 percent for women. In both charts, the mass in the application distribution is greater than the mass in the nonapplication distribution past the intersection point. That is, for both men and women the mass of applicants is greater than the mass of nonapplicants in states with higher allowance rates. This result shows that individual state allowance rates predict the decision to apply for benefits; however, it does not show a structural or causal relationship.

We used the Kolmogorov-Smirnov test to determine whether the two distributions in each chart are statistically different. The details of the kernel density estimation procedure and the Kolmogorov-Smirnov test are provided in Appendix A. The Kolmogorov-Smirnov test statistic for equality within the two first-year male distributions in Chart 1 is 0.86, less than the 10 percent critical value of 1.22. For the observations in the bottom panel of Chart 1, which shows application behavior in the first 10 years after onset, the test requires the strong assumption that there is no serial correlation within person-year observations. Given that assumption, the Kolmogorov-Smirnov test statistic for the 10-year distributions is significant at the 5 percent level.

The Kolmogorov-Smirnov test statistic for the two first-year female distributions is 1.37, greater than the 5 percent critical value of 1.36. The two distributions for the 10-year period are also significantly different, but again the test requires the strong assumption of no serial correlation within person-year observations.

To further illustrate the relationship between the state allowance rate and DI application, Table 4 shows the mass of men and women above the intersection of the two kernel density estimates of the first-year distributions. It also shows the estimated difference between the upper tail masses in the two samples and their t-values.

The percentage of both men and women in the region above the intersection who apply for DI benefits within the first year following the onset of a work-limiting health condition is greater than the percentage who do not apply. For men, 38.3 percent of the sample who apply have an allowance rate above the intersection, compared with only 32.9 percent of those who do not apply. The difference of 5.4 percentage points appears large, but because we observe only 94 men applying within the first period after onset, the standard error of the difference is too large to infer that the difference is statistically significantly different from zero. For women, the intersection occurs below the median of each sample. That is, 68.2 percent of women who apply for DI benefits have a state allowance rate above the intersection, compared with 53.4 percent of those who do not apply. The difference of 14.8 percentage points is statistically significant at the 5 percent level. These results show that the state allowance rate predicts the decision to apply for DI benefits following the onset of a work-limiting health

Table 2.
Descriptive statistics for variables, by sex

Variable	Men	Women
Spell length		
Apply	0.562	0.534
	(0.497)	(0.499)
Policy		
State allowance rate (year 1)	0.371	0.368
	(0.075)	(0.069)
State allowance rate (year 5)	0.360	0.359
	(0.065)	(0.065)
State allowance rate (year 10)	0.370	0.369
	(0.065)	(0.071)
Expected DI benefit (year 1)/1,000	6.853	4.379
	(2.727)	(2.151)
Expected DI benefit (year 5)/1,000	7.603	4.857
	(2.772)	(2.230)
Expected DI benefit (year 10)/1,000	8.108	5.307
	(2.416)	(1.947)
Employer accommodation	0.266	0.268
	(0.442)	(0.443)
Economic		
Expected earnings (year 1)/1,000	18.866	9.589
	(19.215)	(8.169)
Expected earnings (year 5)/1,000	19.990	10.783
	(16.954)	(9.597)
Expected earnings (year 10)/1,000	21.202	12.082
	(19.403)	(15.080)
Real earnings growth (year 1)	-0.126	-0.047
	(0.190)	(0.214)
Real earnings growth (year 5)	-0.093	-0.069
	(0.256)	(0.205)
Real earnings growth (10 years)	-0.057	-0.022
	(0.171)	(0.362)
State unemployment rate (year 1)	0.071	0.069
	(0.021)	(0.020)
State unemployment rate (year 5)	0.069	0.068
	(0.020)	(0.019)
State unemployment rate (year 10)	0.069	0.068
	(0.022)	(0.023)
Spouse works at onset	0.503	0.543
	(0.500)	(0.499)
Accident at work	0.307	0.237
	(0.462)	(0.426)
Caused by nature of work	0.500	0.391
	(0.500)	(0.489)

Variable	Men	Women
Economic (continued)		
No savings at onset	0.834	0.808
	(0.372)	(0.395)
Experience/100	1.005	0.668
	(0.335)	(0.315)
Tenure	14.873	9.436
	(10.421)	(7.621)
Tenure missing	0.179	0.193
	(0.383)	(0.395)
A lot of physical effort	0.678	0.643
	(0.468)	(0.480)
Heavy lifting	0.486	0.442
	(0.500)	(0.497)
Stoop, kneel, and crouching	0.585	0.496
	(0.493)	(0.501)
Good eyesight	0.890	0.919
	(0.314)	(0.274)
Intense concentration	0.869	0.891
	(0.338)	(0.313)
Keep pace with others	0.657	0.697
	(0.475)	(0.460)
Skill dealing with people	0.754	0.821
	(0.431)	(0.384)
White collar	0.160	0.153
	(0.367)	(0.361)
Manager	0.091	0.056
	(0.288)	(0.230)
Professional	0.069	0.097
	(0.254)	(0.297)
Sales	0.048	0.097
	(0.214)	(0.297)
Clerical	0.055	0.235
	(0.228)	(0.425)
Service	0.087	0.292
	(0.282)	(0.455)
Craftsperson	0.283	0.043
	(0.451)	(0.204)
Laborer	0.354	0.179
	(0.479)	(0.384)
Military	0.012	0.000
	(0.111)	(0.000)
Occupation missing	0.026	0.019
	(0.159)	(0.137)

Continued

Table 2.
Continued

Variable	Men	Women
Economic (continued)		
Agriculture	0.034	0.015
	(0.181)	(0.122)
Mining	0.141	0.004
	(0.349)	(0.066)
Manufacturing	0.336	0.219
	(0.473)	(0.414)
Transportation	0.145	0.041
	(0.352)	(0.199)
Wholesale, retail, financial	0.143	0.273
	(0.351)	(0.446)
Service	0.039	0.117
	(0.195)	(0.322)
Professional service	0.088	0.303
	(0.283)	(0.460)
Public administration	0.073	0.028
	(0.261)	(0.166)
Industry missing	0.031	0.021
	(0.174)	(0.144)
Less than 5 employees	0.045	0.066
	(0.207)	(0.248)
5-14 employees	0.066	0.071
	(0.248)	(0.256)
15-24 employees	0.038	0.039
	(0.192)	(0.194)
25-99 employees	0.145	0.141
	(0.352)	(0.349)
100-499 employees	0.134	0.146
	(0.341)	(0.354)
500 or more employees	0.572	0.538
	(0.495)	(0.499)
Employer size missing	0.185	0.129
	(0.389)	(0.336)
Pension	0.704	0.516
	(0.457)	(0.500)
Pension missing	0.099	0.133
	(0.299)	(0.340)
Union	0.450	0.248
	(0.498)	(0.432)
Union missing	0.184	0.127
	(0.388)	(0.333)
Veteran	0.542	0.004
	(0.499)	(0.065)

Variable	Men	Women
Health		
Two health conditions at onset	0.219	0.259
	(0.414)	(0.439)
Three or more health conditions at onset	0.123	0.157
	(0.329)	(0.364)
Cancer	0.028	0.049
	(0.164)	(0.216)
Musculoskeletal	0.493	0.675
	(0.500)	(0.469)
Paralysis	0.036	0.021
	(0.188)	(0.144)
Cardiovascular	0.363	0.159
	(0.481)	(0.366)
Respiratory	0.109	0.104
	(0.312)	(0.306)
Endocrine, Digestive	0.118	0.110
	(0.323)	(0.314)
Neurological	0.073	0.093
	(0.260)	(0.291)
Emotional	0.026	0.057
	(0.159)	(0.233)
Miscellaneous	0.047	0.074
	(0.212)	(0.263)
Demographic		
Education/100	0.109	0.115
	(0.035)	(0.027)
Age/100	0.497	0.477
	(0.065)	(0.065)
Spouse	0.831	0.662
	(0.375)	(0.474)
White	0.666	0.675
	(0.472)	(0.469)
Black	0.199	0.219
	(0.400)	(0.414)
Other	0.135	0.106
	(0.342)	(0.308)

SOURCE: Authors' calculations based on wave 1 of the HRS data.

NOTES: Sample size for men is 577. Sample size for women is 472. Sample is based on using the year in which the health condition first began to bother the person. Standard deviations are in parentheses.

Table 3.
Kaplan-Meier estimates of the time to application for DI for men and women

Years since onset	Men				Women			
	Survival rate	Apply	Censor	Hazard	Survival rate	Apply	Censor	Hazard
1	1.00	94	14	0.16	1.00	63	7	0.13
2	0.84	69	22	0.15	0.87	55	25	0.14
3	0.71	47	25	0.13	0.74	27	23	0.09
4	0.62	23	9	0.08	0.68	24	21	0.09
5	0.57	22	19	0.08	0.62	16	17	0.07
6	0.52	20	22	0.09	0.57	13	21	0.07
7	0.48	10	15	0.05	0.53	14	19	0.09
8	0.45	8	21	0.05	0.48	7	15	0.06
9	0.43	6	14	0.05	0.45	6	9	0.06
10	0.41	4	11	0.04	0.43	5	10	0.06
Total		324	253			252	220	

SOURCE: Authors' calculations based on wave 1 of the HRS data.
NOTES: Totals capture the number for all observations in the sample (577 men and 472 women). Onset of a work-limiting health condition is defined as the year the health condition first began to bother the person.

condition, but they do not show a structural or causal relationship.[21]

Employer Accommodation and the Time to Application

Table 5 provides life-table risks of applying for DI benefits for men who are and are not accommodated by their employer following the onset of their work-limiting health condition. The table also describes the difference in the hazard of DI application across responses for each time period and an estimated t-value. The overall difference in the risk of applying for benefits across responses for all time periods is estimated and tested using a Cox proportional hazard model.

Men who are accommodated have a significantly smaller risk of applying for DI over the first three periods following onset. Furthermore, the Cox proportional hazard model estimate indicates that they have, on average, a significantly smaller risk of applying for DI benefits (0.44 times that of those who do not receive accommodation). The results for women are similar (see Table 5).[22]

Hazard Model Estimates

Table 6 shows the results of the hazard model.[23] It shows the variables used in the model and the estimated coefficient and the asymptotic t-value of the model parameters for men and women. The coefficients in Table 6 are transformed into marginal impacts to show the effects of variables on the probability of application and expected duration in Table 7.

The policy variables in Table 6 affect the application hazard in the predicted direction and are statistically significant for both men and women. Holding other variables in the model constant, an increase in the state allowance rate or in

Table 4.
Percentage of workers within the first year of the onset of a work-limiting health condition living in a state with an allowance rate above the intersection point of the kernel density estimates

Sex	Percentage of persons above intersection		Difference (apply–not apply)	
	Apply	Not apply	Difference	t-value
Men[a]	38.3	32.9	5.38	0.98
	-5	-2.14	-5.49	
Women[b]	68.2	53.4	14.8	2.38
	-5.73	-2.38	-6.21	

SOURCE: Authors' calculations based on the Lewin Group (1995) initial state allowance rates merged with wave 1 of the HRS data.

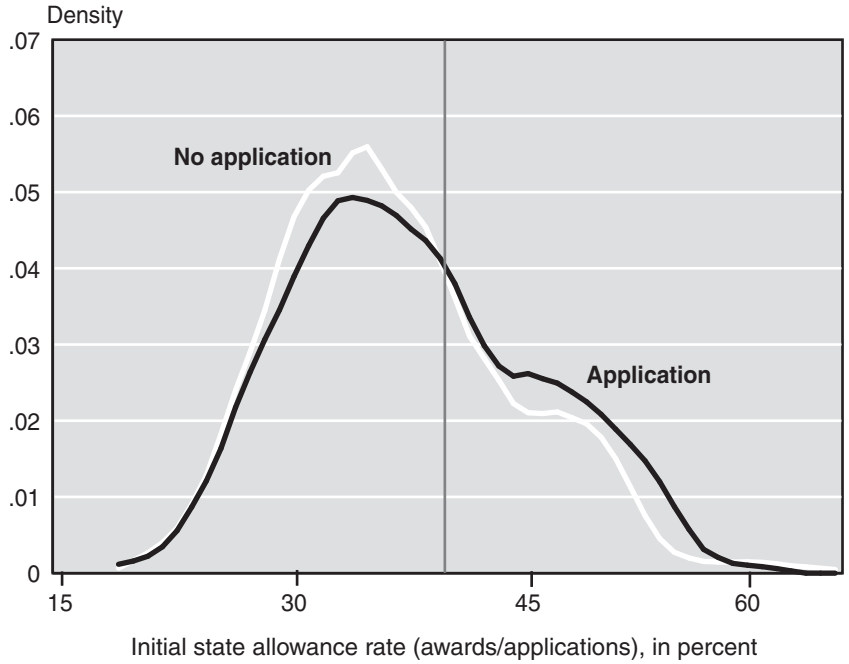
NOTE: The onset of a work-limiting health condition is defined as the year the health condition first began to bother the person.

a. Kernel density estimates cross at an initial state allowance rate of 0.395.

b. Kernel density estimates cross at an initial state allowance rate of 0.355.

Chart 1.
Kernel density estimates of the distribution of male applicants and nonapplicants in the year following the onset of disability, by state allowance rate

In the first year following the onset of disability

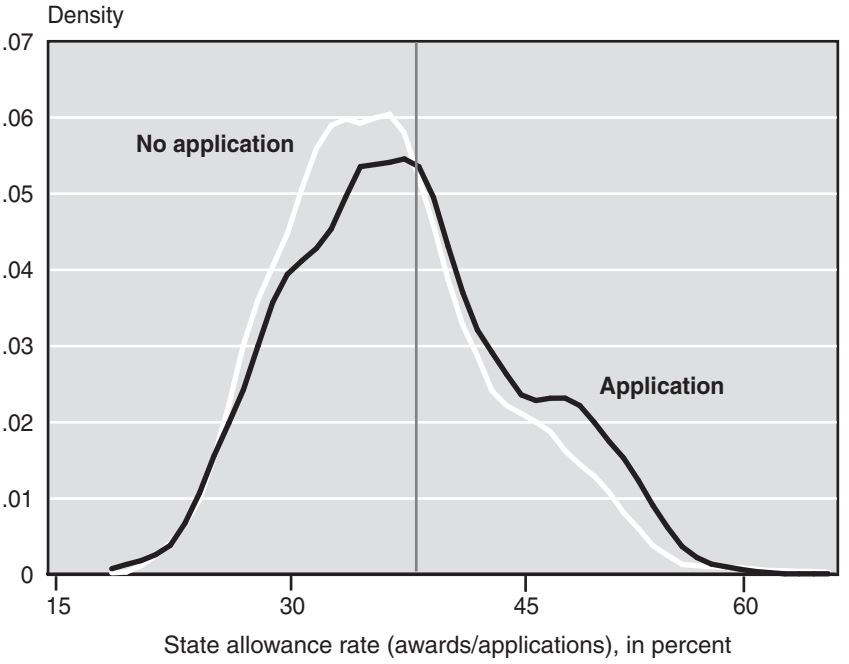


No application
Mean: 0.361
Median: 0.361
Std. Dev.: 0.068
Total: 2,463

Application
Mean: 0.368
Median: 0.361
Std. Dev.: 0.073
Total: 308

Distribution crosses at 0.385

In the first 10 years following the onset of disability [a]



No application
Mean: 0.368
Median: 0.361
Std. Dev.: 0.075
Total: 482

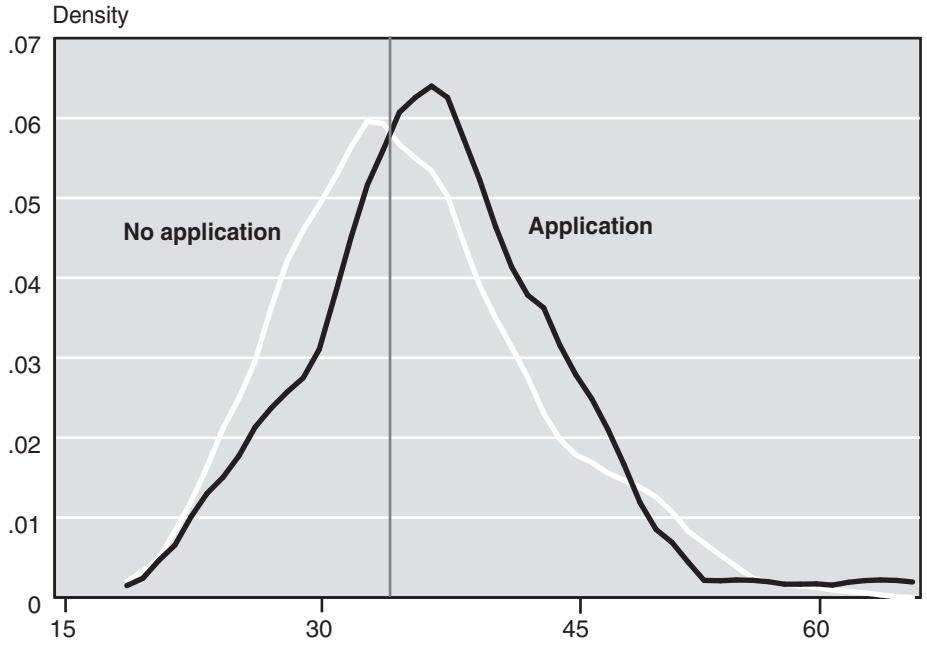
Application
Mean: 0.379
Median: 0.367
Std. Dev.: 0.077
Total: 94

Distribution crosses at 0.395

SOURCE: Authors' calculations based on wave 1 of the HRS data.
NOTE: Onset of a work-limiting health condition is defined as the year the health condition first began to bother the person.
a. Includes all person-year pairs for the first 10 years following onset.

Chart 2.
Kernel density estimates of the distribution of female applicants and nonapplicants following the onset of disability, by state allowance rate

In the first year following the onset of disability

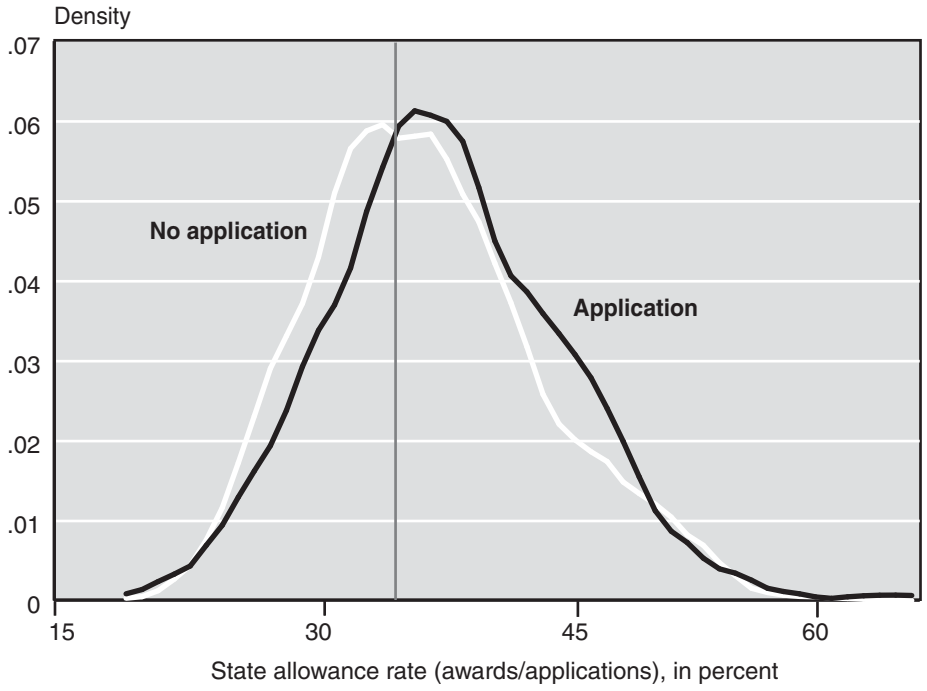


No application
Mean: 0.367
Median: 0.361
Std. Dev.: 0.070
Total: 402

Application
Mean: 0.382
Median: 0.376
Std. Dev.: 0.071
Total: 63

Distribution crosses at 0.355

In the first 10 years following the onset of disability [a]



No application
Mean: 0.360
Median: 0.355
Std. Dev.: 0.068
Total: 2,193

Application
Mean: 0.372
Median: 0.367
Std. Dev.: 0.068
Total: 245

Distribution crosses at 0.343

SOURCE: Authors' calculations based on wave 1 of the HRS data.
NOTE: Onset of a work-limiting health condition is defined as the year the health condition first began to bother the person.
a. Includes all person-year pairs for the first 10 years following onset.

the expected DI benefit increases the hazard of DI application and employer accommodation reduces it.

Most of the economic and demographic variables in the model also influence application behavior in the expected direction. Persons with higher expected earnings and those with higher variance of earnings have a lower hazard of DI application. So both the level and the variance of earnings (associated with growth) matter, as Kreider (1998, 1999b) emphasized. Persons who live in states with a higher unemployment rate have a higher hazard of DI application. The estimated coefficients are statistically significant for both men and women. Education, age at onset, and experience have signs consistent with the earlier predictions. However, experience for

Table 5.
Kaplan-Meier estimates of the time to application for DI for men and women, by employer accommodation

Years since onset	Not accommodated (n=424)				Accommodated (n=153)				Hazard difference	
	Survival rate	Number who applied	Number censored	Hazard rate	Survival rate	Number who applied	Number censored	Hazard rate	Estimate	t-value
					Men					
1	1.00	88	6	0.21	1.00	6	8	0.04	-0.17	-6.12
2	0.79	57	10	0.18	0.96	12	12	0.09	-0.09	-2.45
3	0.65	39	19	0.15	0.87	8	6	0.07	-0.08	-2.34
4	0.55	16	5	0.08	0.81	7	4	0.07	-0.01	-0.25
5	0.51	18	11	0.10	0.75	4	8	0.05	-0.05	-1.64
6	0.46	15	15	0.10	0.72	5	7	0.07	-0.03	-0.87
7	0.41	7	13	0.06	0.67	3	2	0.05	-0.01	-0.37
8	0.39	5	10	0.05	0.64	3	11	0.05	0	0.11
9	0.37	4	10	0.05	0.60	2	4	0.04	0	-0.07
10	0.35	4	6	0.05	0.58	0	5	0	-0.05	-1.05
Total		266	158			58	95			
					Women					
1	1.00	58	4	0.17	1.00	5	3	0.04	-0.13	-4.52
2	0.83	48	16	0.17	0.96	7	9	0.06	-0.11	-3.28
3	0.69	20	16	0.09	0.90	7	7	0.07	-0.02	-0.68
4	0.62	19	11	0.11	0.84	5	10	0.06	-0.05	-1.27
5	0.56	12	13	0.08	0.79	4	4	0.06	-0.03	-0.68
6	0.51	12	11	0.10	0.74	1	10	0.02	-0.08	-2.47
7	0.46	10	14	0.10	0.73	4	5	0.08	-0.02	-0.46
8	0.41	6	10	0.08	0.67	1	5	0.02	-0.05	-1.38
9	0.38	5	6	0.08	0.66	1	3	0.03	-0.05	-1.19
10	0.35	2	7	0.04	0.64	3	3	0.09	0.05	0.87
Total		202	144			50	76			

SOURCE: Authors' calculations based on wave 1 of the HRS data.
NOTES: Onset of a work-limiting health condition is defined as the year the health condition first began to bother the person. Totals capture the number for all observations in the sample. One person with missing accommodation information was coded as not accommodated.

Estimates for accommodation in the Cox proportional hazard model are as follows:

	Men	Women
Estimates	0.53	-0.48
Standard error	0.16	0.17
Relative risk	0.59	0.62

men and education for women are not significant at the 5 percent level.

The effect of a white-collar job is negative, implying that persons in white-collar jobs have lower DI application hazards, but it is statistically significant only for women. The presence of a spouse at onset increases the hazard of application for men and decreases it for women, but those coefficients are not statistically significant at the 5 percent level. Relative to whites, both blacks and members of other races tend to have higher DI application hazards, but the coefficients are statistically significant only for blacks. For women, the variable "SSA record missing" is positive; that is, women who did not grant permission to have their records matched to the HRS data had a higher hazard of DI application. The effect was not significant at the 5 percent level but was statistically significant at the 10 percent level.[24] For men, the effect was not statistically significant.

Health conditions have the predicted effects and are statistically significant at the 5 percent level for both men and women. Persons with two or more conditions at onset have a higher hazard of DI application. Persons with musculoskeletal conditions tend to have smaller application hazards and to delay application. The effect of cardiovascular conditions cannot be distinguished from the reference group of all other health conditions contained in the constant.[25]

Table 6.
Hazard model estimates of the risk of DI application following the onset of disability

	Men		Women	
Variable	Coefficient	t-value	Coefficient	t-value
Constant	-6.140	-5.330	-6.890	-4.700
State allowance rate	2.150	2.100	3.950	2.740
Expected DI benefit	0.160	2.790	0.390	4.430
Accommodation	-0.790	-3.520	-0.740	-2.910
Expected earnings	-0.050	-5.010	-0.140	-5.820
Real earnings growth	-1.470	-5.130	-0.480	-1.470
State unemployment rate	7.560	2.150	9.060	2.000
Experience	0.370	0.830	-0.250	-0.490
White-collar job	-0.080	-0.340	-0.650	-2.070
Two health conditions[a]	0.460	2.370	0.460	2.010
Three health conditions[a]	0.910	3.150	1.020	3.330
Musculoskeletal[b]	-0.860	-4.080	-0.670	-2.890
Cardiovascular[b]	0.050	0.240	0.010	0.030
Education	-5.660	-2.150	-7.080	-1.880
Age	4.910	3.070	6.230	3.180
Married	0.120	0.570	-0.029	-1.470
Black	0.580	2.590	0.550	2.160
Other race[c]	0.310	1.200	0.120	0.360
SSA record missing	0.370	1.950	0.600	2.640
Time	-0.050	-0.490	0.030	0.330
Time squared	0.002	0.310	0.001	0.100
Variance of heterogeneity	0.760	1.050	1.000	2.100

SOURCE: Authors' calculations based on wave 1 of the HRS data.

NOTES: Onset of disability is defined as the year the health condition first began to bother the person. The sample includes 577 men and 472 women. The log-likelihood is 901.43 for men and 718.19 for women.

a. Reference category is one health condition at onset.

b. Reference category is all other health conditions.

c. Reference category is white race.

Marginal Effects

The coefficients in Table 6 measure the size of the impact that the explanatory variables have on the log hazard of DI application, a rather arcane concept. In Table 7, we measure the magnitude of the effects of the variables in the hazard model by taking the derivative of four outcomes of interest with respect to explanatory variables of interest. The outcomes are the probability of applying for benefits within 5, 10, or 15 years and the expected duration until application. Because the equations are nonlinear, the point at which the derivatives are evaluated affects the results. We evaluate marginal impacts at the sample means.

Table 7 presents the same variables as in Table 6 and, for men and women, the estimated probability of application within the first 5 years, 10 years, and 15 years after the onset of disability and the estimated expected time from onset to DI application. The table also shows the estimated mean outcomes for each interval and the estimated mean outcome based on a change of 20 percent in the explanatory variables from its mean level.

The first row of Table 7 shows the estimates for each outcome evaluation at the sample means. For the men in the sample, 34 percent are estimated to apply within the

first 5 years, 54 percent within the first 10 years, and 67 percent within the first 15 years after onset. The expected duration to application is 10.22 years. For women, 27 percent are expected to apply within 5 years, 51 percent within 10 years, and 70 percent within 15 years. The expected duration for women is 10.58 years. The rows that follow show the estimated impact of each variable's effect on these estimated outcomes.

Table 7 also shows the effect of policy variables on the decision to apply for DI benefits. A 20 percent increase in the state allowance rate would increase mean allowance rates from about 36 percent to about 43 percent. That increase represents a movement in the distribution of one standard deviation and is well within the range of the data. Such an increase would boost applications by 4 percentage points within the first 5 years, increasing the expected exit rate from 34 percent to 38 percent. The marginal effect is an increase of 6 percentage points within 10 years and within 15 years. Finally, a 20 percent increase in the state allowance rate would reduce the time to application by 0.88 years. For women, the changes are even greater.

The marginal impact of the expected DI benefits is also shown in Table 7. An increase of 20 percent in the DI benefits would amount to a change from about $6,800 to about $8,160 in the first year and an increase from about $7,800 to $9,360 in year 10 for men. That increase represents a movement in the distribution of one standard deviation and is well within the range of our data. The increase raises the share of men applying within 5 years by 6 percentage points and by an additional 8 percentage points within 10 years and within 15 years following the onset of a work-limiting health condition. It reduces the time to DI application by 1.20 years. For women the marginal changes are higher.

The impact of universal employer accommodation is outside the range of our data but is a useful measure of the maximum effect of the ADA. Universal employer accommodation would reduce men's DI applications by 21 percentage points within 5 years, 28 percentage points

Table 7.
Estimated probabilities of men and women applying for DI within 5, 10, and 15 years after the onset of disability

	Men's probability of application				Women's probability of application			
Variable	Within 5 years	Within 10 years	Within 15 years	Time to application	Within 5 years	Within 10 years	Within 15 years	Time to application
Outcome at sample means	0.340	0.540	0.670	10.220	0.270	0.510	0.700	10.580
State allowance rate[a]	0.040	0.060	0.060	-0.880	0.070	0.100	0.100	-1.470
Expected DI benefit[a]	0.060	0.080	0.080	-1.200	0.080	0.120	0.120	-1.730
Accommodation	-0.210	-0.280	-0.290	4.360	-0.170	-0.260	-0.270	3.760
Expected earnings[a]	-0.050	-0.070	-0.070	1.080	-0.060	-0.090	-0.090	1.340
Real earnings growth[a]	0.010	0.010	0.010	-0.200	0.001	0.002	0.002	-0.020
State unemployment rate[a]	0.030	0.040	0.040	-0.059	0.030	0.040	0.050	-0.630
Experience[a]	0.020	0.030	0.030	-0.410	-0.010	-0.010	-0.010	0.170
White-collar job	-0.020	-0.030	-0.030	0.460	-0.150	-0.230	-0.230	3.300
Two health conditions	0.130	0.170	0.170	-2.550	0.110	0.160	0.170	-2.330
Three health conditions	0.250	0.330	0.330	-5.020	0.240	0.360	0.370	-5.190
Musculoskeletal	-0.230	-0.310	-0.310	4.720	-0.150	-0.230	-0.240	3.400
Cardiovascular	0.010	0.020	0.020	-0.250	0.002	0.002	0.003	-0.040
Education[a]	-0.030	-0.040	-0.050	0.680	-0.040	-0.060	-0.060	0.830
Age[a]	0.130	0.170	0.180	-2.680	0.140	0.210	0.210	-3.020
Married	0.030	0.040	0.040	-0.660	-0.070	-0.100	-0.100	1.480
Black	0.160	0.210	0.210	-3.220	0.130	0.190	0.200	-2.790
Other race	0.080	0.110	0.110	-1.690	0.030	0.040	0.040	-0.620
SSA record missing	0.100	0.130	0.140	-2.040	0.140	0.210	0.220	-3.070

NOTES: Reference categories are the same as in Table 6. All dummy variables are measured as a change from 0 to 1.
Onset of disability is defined as the year the health condition first began to bother the person.
a. Marginal effect based on a 20 percent increase evaluated at the mean.

within 10 years, and 29 percentage points within 15 years after onset. Expected time to application would increase by 4.36 years. The maximum impact of accommodation is slightly smaller for women (3.76 years).

The impact of a 20 percent change in accommodation would be one-fifth of those marginal impacts. For example, time to application would increase by 0.87 years for men on average.[26]

Note that because of potential endogeneity of accommodation, expected benefits, and state allowance rates, all predictions include both the structural impact and a potential reverse causal relationship. The controls for health and other sociodemographic variables, as well as for expected earnings and the variance of earnings, reduce the endogeneity problems to some degree but not to zero. All policy impacts are upper-bound estimates.

Conclusions and Policy Implications

The institutional environment that workers with a work-limiting health condition face can have a significant effect on the timing of their DI application. Using retrospective data from the HRS we show that Social Security policy variables—the state allowance rate and the size of DI benefits—significantly influence the time to DI application.

When we compare across states the kernel density estimates of the distribution of persons who apply for DI benefits soon after their work-limiting health condition begins to bother them, ordered by the state's allowance rate, with the same distribution for those who do not apply for benefits, we find that a greater mass of early applicants live in states with a high allowance rate. Using a hazard model to control for both observed and unobserved heterogeneity, we find that states with higher allowance rates increase the hazard of DI application. A 20 percent increase in state allowance rates at the mean value of all other variables would reduce men's expected duration before application for DI benefits by 0.88 years, from 10.22 to 9.34 years. The decline for women is even larger—from 10.58 to 9.11 years.

In that same hazard model we find that persons with larger potential DI benefits also have a significantly greater risk of DI application. A 20 percent increase in benefits would reduce expected duration for men by 1.2 years and for women by 1.7 years.

The Americans with Disabilities Act of 1990 was meant to increase the willingness of employers to provide accommodation to workers with disabilities. Using a life table we show that accommodation of workers following the onset of their work-limiting health condition lowers the risk of applying for DI benefits within the first 3 years after onset. When employer accommodation is included in the hazard model, it predicts significantly reduced risk of application. Universal employer accommodation would increase expected duration by 4.36 years for men and by 3.76 years for women.

Our results suggest that most workers with work-limiting health conditions do not immediately apply for DI benefits after their health condition first begins to bother them. The median man did not apply for DI benefits until the 7th year following the onset of his health condition. The median woman did not apply until the 8th year.

Health has a significant influence on application for benefits. Within the population with disabilities, the severity and type of one's health condition influence the time to application. Those with multiple conditions apply significantly sooner. Those with musculoskeletal conditions are significantly slower to apply than those with other conditions.

Economic and demographic variables also significantly influence time to application. Workers with higher labor earnings, those with higher variance (equivalent to wage growth here), those who live in states with a lower unemployment rate, those with more years of education, as well as those who were younger at onset and who are nonblack are all slower to apply for benefits.

Policy variables significantly predict the time to application. The importance attached to the results depends on the degree to which we have controlled for the decision by states to approve more or fewer applicants, for employers to accommodate workers, and for benefit levels to be related to unmeasured factors that affect application. Our findings are upper-bound estimates, but they suggest that moving toward pro-work policies that, for instance, encourage greater employer accommodation following the onset of a work-limiting health condition or away from policies that make DI easier to obtain and more valuable to receive would significantly slow the time to DI application.

Appendix A. Kernel Density Estimates of the Initial State Allowance Rates

Kernel density estimation is a nonparametric technique for estimating the probability density function of data. Kernel density estimators are similar to histograms in that they show the fraction of total observations for specified intervals of the data. In histograms, the intervals are not allowed to overlap, and the fraction of total observations that fall into the interval are assigned to the midpoint of the interval. A bar graph that assigns the fraction of all observations that fall within the interval to each value within the interval is used to describe the data.

In kernel density estimation, intervals are allowed to overlap, resulting in a smoothed picture of the distribution. Estimation of the distribution is accomplished by sliding a window, or kernel, over the entire range of the data and placing progressively smaller weight on observations further away from the center of the window. The weighted average of observations within the window is assigned to the midpoint of the window as it slides along the entire range of the data. A kernel function is used to assign the weights. In theory, any kernel that integrates to 1 will lead to consistent estimates of the distribution (Silverman 1986).

The first step in kernel density estimation is the choice of the kernel function and the width of the sliding window, called the bandwidth. The Epanechnikov kernel is a popular choice for the kernel, and it is the one used to estimate the distributions in this article. Equation A-1 shows the mathematical form of the Epanechnikov kernel.

$$K[z]=\begin{cases}\frac{3}{4\sqrt{5}}\left(1-\frac{1}{5}z^2\right) & if\ |z|<\sqrt{5}\\ 0 & otherwise,\end{cases} \qquad \text{(A-1)}$$

$$where\ z=\left[\frac{x-X_i}{h}\right]$$

In these equations, z represents the standardized distance from the center of the window. In the computation of z, x is the center, X_i is the observed value of the data, and h is the bandwidth.

A standard bandwidth used in kernel density estimation is the width that would minimize the mean square error if the data were from a normal distribution. The mathematical representation of this width is shown in A-2.

$$h=\frac{0.9m}{n^{\frac{1}{5}}},\ where\ m=\min\left(\sqrt{Variance_x},\frac{Interquartile\ Range_x}{1.349}\right) \qquad \text{(A-2)}$$

In equation A-2, x represents the entire set of data—for example, the set of allowance rates for disabled men—and n represents the number of observations. The kernel density estimator is then determined as a weighted average as shown in equation A-3.

$$\hat{f}_K=\frac{1}{nh}\sum_{i=1}^{n}K[z] \qquad \text{(A-3)}$$

The Kolmogorov-Smirnov test for equality for two samples is used to test the hypothesis that the distribution of allowance rates for persons who applied for Social Security Disability Insurance within the first period is the same as the distribution for those who had not applied within the first period. The cumulative distribution function for persons who applied is represented by $F_A(x)$, and the distribution of allowance rates for persons who did not apply within the first period is represented by $F_N(x)$. The null hypothesis of the test is that the cumulative density functions are the same for the entire range of a random variable x. Equation A-4 describes the null hypothesis.

$$\begin{aligned}&H_0: F_N(x)=F_A(x) \quad for -\infty \le x \le 0\\ &H_A: The\ hypothesis\ H_0\ is\ not\ true.\end{aligned} \qquad \text{(A-4)}$$

A test statistic, denoted $D_{m,n}$, has been derived (DeGroot 1986) based on a standardized difference in cumulative density functions as shown in equation A-5.

$$D_{m,n}=\left(\frac{mn}{m+n}\right)^{\frac{1}{2}}\cdot \sup_{-\infty\le x\le\infty}\left|F_N(x)-F_A(x)\right| \qquad \text{(A-5)}$$

In equation A-5, m represents the number of observed persons who had applied for the program, and n represents the number of observed persons who did not apply. The limiting distribution of this test statistic can be found in DeGroot (1986) or any other intermediate statistics textbook, and probabilities for realized values of the test statistic are in DeGroot (1986, 555).

Appendix B. State Data and Analysis Using an Alternative Definition of the Onset of Disability

The first two tables in this appendix provide information on the state-level data. Table B-1 describes the variation in the allowance rate and unemployment rate across states. Table B-2 describes the variation in the allowance rate and unemployment rate from 1974 to 1993.

The remaining tables, Appendix Tables B-3 through B-9, repeat the analysis in the text using an alternative definition of the onset of disability—the year the impairment first began to interfere with a person's ability to perform paid work. After applying the same selection rules that were described in the data section, we created a sample of 572 men and 469 women for the analysis. The results are similar to those using the date that the impairment first began to bother the person as the definition of the onset of disability.

Appendix Table B-1.
Mean of each state's DI allowance and unemployment rates, 1974-1993 (in percent)

	State allowance rate		State unemployment rate	
Current state of residence	Mean	Standard deviation	Mean	Standard deviation
Alabama	32	4.8	8.4	2.4
Arizona	41	6.0	6.9	1.6
Arkansas	32	5.6	7.6	1.4
California	37	7.5	7.5	1.5
Colorado	40	5.8	6.0	1.0
Connecticut	45	8.9	5.8	1.7
Delaware	48	4.7	6.5	1.9
District of Columbia	39	8.0	8.0	1.6
Florida	37	6.4	6.9	1.5
Georgia	33	7.2	6.3	1.0
Illinois	37	5.8	7.4	1.8
Indiana	40	7.3	7.2	2.1
Iowa	44	8.7	5.3	1.7
Kansas	41	5.2	4.6	0.8
Kentucky	33	3.8	7.4	2.0
Louisiana	28	8.4	8.7	2.2
Maine	44	6.1	6.8	1.8
Maryland	37	5.1	5.8	1.2
Massachusetts	44	7.8	6.4	2.2
Michigan	37	6.8	9.6	2.6
Minnesota	45	7.5	5.4	1.1
Mississippi	31	5.9	8.5	2.0
Missouri	38	6.8	6.4	1.3
Montana	37	6.5	6.8	1.0
Nebraska	43	6.1	3.8	1.1
Nevada	39	6.9	7.0	1.8
New Hampshire	42	5.5	5.1	1.7
New Jersey	48	9.4	6.9	2.0
New Mexico	28	5.3	7.6	1.3
New York	41	9.2	7.3	1.6
North Carolina	40	6.1	5.8	1.6
North Dakota	42	5.9	4.6	1.0
Ohio	42	7.8	7.6	2.2
Oklahoma	33	6.7	5.9	1.5
Oregon	37	6.7	7.9	1.9
Pennsylvania	39	7.4	7.4	1.8
Rhode Island	48	4.7	6.9	2.1
South Carolina	37	4.7	6.8	1.7
South Dakota	46	4.5	4.0	0.9
Tennessee	35	6.4	7.1	2.0
Texas	34	6.2	6.3	1.3
Utah	45	5.9	5.6	1.4
Vermont	46	5.3	6.0	1.8
Virginia	36	3.4	5.3	1.0
Washington	40	8.4	8.0	1.8
West Virginia	30	8.3	10.2	3.1
Wisconsin	46	6.5	6.2	1.9
Wyoming	39	5.1	5.5	1.8
All states	39	8.2	6.7	2.1

SOURCE: Authors' calculations based on the Lewin Group (1995) data on state allowance and unemployment rates from 1974 through 1993.

Appendix Table B-2.
Mean of state DI allowance and unemployment rates for all states, 1974-1993 (in percent)

	State allowance rate		State unemployment rate	
Year	Mean	Standard deviation	Mean	Standard deviation
1974	49	6.2	5.4	1.5
1975	50	6.3	7.8	2.1
1976	48	5.6	7.2	1.9
1977	45	5.6	6.7	1.6
1978	40	6.7	5.7	1.5
1979	36	6.7	5.6	1.4
1980	34	5.5	6.8	1.6
1981	32	4.7	7.3	1.9
1982	31	4.7	9.3	2.3
1983	34	5.9	9.3	2.5
1984	36	6.3	7.3	2.2
1985	37	6.7	7.1	1.9
1986	40	6.7	7.0	2.2
1987	37	6.7	6.3	2.1
1988	37	6.8	5.5	1.9
1989	37	6.7	5.1	1.3
1990	39	6.8	5.4	1.1
1991	41	7.1	6.4	1.5
1992	42	7.0	6.8	1.6
1993	39	6.3	6.3	1.5
All states	39	8.2	6.7	2.1

SOURCE: Authors' calculations based on the Lewin Group (1995) data on state allowance and unemployment rates from 1974 through 1993.

Appendix Table B-3.
Descriptive statistics for variables, by sex

Variable	Men	Women
Spell length		
Apply	0.587	0.550
	(0.021)	(0.023)
Policy		
State allowance rate (year 1)	0.371	0.365
	(0.075)	(0.069)
State allowance rate (year 5)	0.362	0.364
	(0.065)	(0.065)
State allowance rate (year 10)	0.366	0.379
	(0.065)	(0.071)
Expected DI benefit (year 1)	7.018	4.446
	(2.282)	(1.855)
Expected DI benefit (year 5)	7.442	4.695
	(2.247)	(1.873)
Expected DI benefit (year 10)	7.938	4.951
	(1.810)	(1.532)
Employer accommodation	0.270	0.271
	(0.019)	(0.021)
Economic		
Expected earnings (year 1)	16.389	9.143
	(14.083)	(6.672)
Expected earnings (year 5)	17.363	10.201
	(11.812)	(6.921)
Expected earnings (year 10)	16.387	9.868
	(13.813)	(8.706)
State unemployment rate (year 1)	0.071	0.068
	(0.021)	(0.020)
State unemployment rate (year 5)	0.069	0.067
	(0.020)	(0.019)
State unemployment rate (year 10)	0.069	0.066
	(0.022)	(0.023)
Spouse works at onset	0.503	0.537
	(0.021)	(0.023)
Spouse doesn't work at onset	0.325	0.124
	(0.020)	(0.015)
No savings at onset	0.167	0.203
	(0.016)	(0.019)
Experience	1.014	0.682
	(0.290)	(0.273)
Economic (continued)		
Tenure	15.150	9.424
	(9.688)	(6.900)
Tenure missing	0.131	0.145
	(0.014)	(0.016)
A lot of physical effort	0.713	0.662
	(0.019)	(0.022)
Heavy lifting	0.509	0.459
	(0.021)	(0.023)
Stoop, kneel, and crouch	0.603	0.517
	(0.020)	(0.023)
Good eyesight	0.899	0.912
	(0.013)	(0.013)
Intense concentration	0.877	0.886
	(0.014)	(0.015)
Keep pace with others	0.659	0.705
	(0.020)	(0.021)
Skill dealing with people	0.754	0.818
	(0.018)	(0.018)
White collar	0.155	0.152
	(0.015)	(0.017)
Manager	0.083	0.061
	(0.012)	(0.011)
Professional	0.074	0.091
	(0.011)	(0.013)
Sales	0.050	0.096
	(0.009)	(0.014)
Clerical	0.056	0.226
	(0.010)	(0.019)
Service	0.056	0.226
	(0.010)	(0.019)
Craftsperson	0.282	0.044
	(0.019)	(0.009)
Laborer	0.355	0.187
	(0.020)	(0.018)
Military	0.011	0.000
	(0.004)	(0.000)
Occupation missing	0.026	0.019
	(0.007)	(0.006)
Accident at work	0.320	0.230
	(0.020)	(0.019)
Caused by nature of work	0.509	0.397
	(0.021)	(0.023)

Continued

Appendix Table B-3.
Continued

Variable	Men	Women	Variable	Men	Women
Agriculture	0.038	0.017	***Health***		
	(0.008)	(0.006)			
Mining	0.146	0.007	Two health	0.222	0.256
	(0.015)	(0.004)	conditions at onset	(0.017)	(0.020)
Manufacturing	0.335	0.220	Three or more health conditions	0.130	0.165
	(0.020)	(0.019)	at onset	(0.014)	(0.017)
Transportation	0.141	0.039	Cancer	0.026	0.049
	(0.015)	(0.009)		(0.007)	(0.010)
Wholesale, retail, financial	0.137	0.257	Musculoskeletal	0.506	0.682
	(0.014)	(0.020)		(0.021)	(0.022)
Service	0.038	0.113	Paralysis	0.037	0.021
	(0.008)	(0.015)		(0.008)	(0.007)
Professional service	0.090	0.318	Cardiovascular	0.363	0.160
	(0.012)	(0.022)		(0.020)	(0.017)
Public administration	0.074	0.028	Respiratory	0.109	0.105
	(0.011)	(0.008)		(0.013)	(0.014)
Industry missing	0.031	0.021	Endocrine, digestive	0.117	0.109
	(0.007)	(0.007)		(0.013)	(0.014)
Less than 5 employees	0.046	0.060	Neurological	0.074	0.098
	(0.009)	(0.011)		(0.011)	(0.014)
5-14 employees	0.068	0.067	Emotional	0.026	0.060
	(0.011)	(0.012)		(0.007)	(0.011)
15-24 employees	0.042	0.037	Miscellaneous	0.047	0.075
	(0.008)	(0.009)		(0.009)	(0.012)
25-99 employees	0.147	0.149	***Demographic***		
	(0.015)	(0.016)			
100-499 employees	0.134	0.141	Education	0.108	0.115
	(0.014)	(0.016)		(0.036)	(0.027)
500 or more employees	0.564	0.546	Age	0.503	0.485
	(0.021)	(0.023)		(0.064)	(0.063)
Employer size missing	0.192	0.134	Spouse	0.823	0.661
	(0.016)	(0.016)		(0.016)	(0.022)
Pension	0.700	0.513	White	0.670	0.682
	(0.019)	(0.023)		(0.020)	(0.022)
Pension missing	0.101	0.130	Black	0.206	0.216
	(0.013)	(0.016)		(0.017)	(0.019)
Union	0.458	0.254	Other	0.124	0.103
	(0.021)	(0.020)		(0.014)	(0.014)
Union missing	0.191	0.128			
	(0.016)	(0.015)			
Veteran	0.554	0.004			
	(0.021)	(0.003)			

SOURCE: Authors' calculations based on wave 1 of the HRS data.
NOTES: Sample is based on using the year in which the health condition first began to interfere with the person's work. Sample size for men is 572. Sample size for women is 469. Standard deviations are in parentheses.

Appendix Table B-4.
Difference between the year the condition first began to bother the person and the year the condition first began to interfere with the job, by sex

	Men			Women		
Difference (years)	Number	Percentage	Cumulative percentage	Number	Percentage	Cumulative percentage
Negative	9	0.5	1.1	8	1.3	1.3
0	554	69.2	70.3	395	65.3	66.6
1	59	7.4	77.7	58	9.6	76.2
2	31	3.9	81.5	25	4.1	80.3
3	20	2.5	84.0	22	3.6	84.0
4	15	1.9	85.9	11	1.8	85.8
5	15	1.9	87.8	15	2.5	88.3
6	7	0.9	88.6	11	1.8	90.1
7	6	0.7	89.4	5	0.8	90.9
8	2	0.2	89.6	5	0.8	91.7
9	5	0.6	90.3	5	0.8	92.6
10	5	0.6	90.9	10	1.7	94.2
Greater than 10	42	5.2	96.1	22	3.7	97.9
Never interfered	31	3.9	100.0	13	2.1	100.0

SOURCE: Authors' calculations based on wave 1 of the HRS data.

Appendix Table B-5.
Kaplan-Meier estimates of the time to application for DI, by sex

	Men				Women			
Year	Survival rate	Number who applied	Number censored	Hazard rate	Survival rate	Number who applied	Number censored	Hazard rate
1	1.00	115	22	0.20	1.00	81	15	0.18
2	0.80	81	22	0.19	0.82	59	27	0.16
3	0.65	50	18	0.15	0.69	34	28	0.12
4	0.55	17	14	0.07	0.60	25	23	0.12
5	0.51	16	19	0.07	0.53	14	16	0.08
6	0.48	16	22	0.08	0.49	10	16	0.07
7	0.44	11	10	0.07	0.45	11	12	0.10
8	0.41	8	16	0.06	0.41	3	16	0.03
9	0.38	8	14	0.07	0.40	7	10	0.09
10	0.36	5	10	0.05	0.36	3	8	0.05
Total		336	236			258	211	

SOURCE: Authors' calculations based on wave 1 of the HRS data. Sample size for men is 572. Sample size for women is 469.

NOTES: Onset of a disability is defined as the year the health condition first began to interfere with the person's work. Fewer than 100 persons have spells that last more than 10 years. The maximum observed spell length is 19 years. Totals capture the number for all observations in the sample.

Appendix Table B-6.
Percentage of workers within the first year of the onset of disability who are living in a state with an allowance rate above the intersection of the kernel density estimates

	Percentage of persons above intersection		Difference (Apply–not apply)	
Sex	Apply within year 1	Do not apply within year 1	Difference	t-value
Men [a]	34.78	25.50	9.28	1.91
	(4.44)	(2.05)	(4.89)	
Women [b]	60.24	50.00	10.24	1.73
	(5.37)	(2.46)	(5.91)	

SOURCE: Authors' calculations based on the Lewin Group (1995) initial state allowance rates merged with wave 1 of the HRS data.
NOTE: The onset of a disability is defined as the year the health condition first began to interfere with the person's work.
a. Kernel density estimates cross at an initial state allowance rate of 0.408.
b. Kernel density estimates cross at an initial state allowance rate of 0.355.

Appendix Table B-7.
Hazard model estimates of the risk of DI application following the onset of disability, by sex

	Men		Women	
Variable	Coefficient	t-value	Coefficient	t-value
Constant	-1.83	-1.78	-2.78	-2.01
State allowance rate	2.03	1.91	3.85	2.79
Expected DI benefit	0.13	2.22	0.25	2.85
Employer accommodation	-0.87	-3.83	-0.51	-2.19
Expected earnings	-0.06	-5.78	-0.14	-5.49
State unemployment rate	6.04	1.75	7.89	1.83
Experience	2.15	1.52	0.82	1.79
White collar	0.12	0.50	-0.31	-1.01
Two health conditions [a]	0.17	0.86	0.54	2.34
Three health conditions [a]	0.59	2.62	0.82	2.66
Musculoskeletal [b]	0.23	0.87	-0.72	-3.06
Cardiovascular [b]	0.16	0.90	0.04	0.14
Education/100	-6.02	-2.28	-7.11	-1.95
Age/100	0.64	1.41	2.71	1.44
Married	0.33	1.68	-0.28	-1.41
Black [c]	0.80	2.87	0.55	2.07
Other [c]	-0.81	-3.97	-0.09	-0.25
SSA record missing	0.16	0.89	0.43	1.96
Time	-0.31	-0.29	-0.15	-0.13
Time squared	-0.37	-0.54	0.14	0.21
Variance of heterogeneity	0.79	1.08	1.00	1.67

SOURCE: Authors' calculations based on wave 1 of the HRS data.
NOTES: Onset of disability is defined as the year the health condition first began to interfere with the person's work. The sample includes 572 men and 469 women. The log-likelihood is 884.68 for men and 693.74 for women.
a. Reference category is one health condition at onset.
b. Reference category is all other health conditions.
c. Reference category is white race.

Appendix Table B-8.
Hazard model estimates of the risk of DI application following the onset of disability, including additional independent variables, by sex

	Men		Women	
Variable	Coefficient	t-value	Coefficient	t-value
Constant	-4.79	-3.04	-6.37	-3.42
State allowance rate	2.54	2.21	3.85	2.56
Expected DI benefits/1,000	0.25	3.58	0.57	5.38
Employer accommodation	-0.76	-3.16	-0.59	-2.22
Expected earnings/1,000	-0.07	-6.13	-0.17	-6.32
State unemployment rate	8.88	2.45	9.62	1.90
Spouse working at onset [a]	0.17	0.64	0.82	2.52
Spouse not working at onset [a]	0.25	0.96	-0.45	-1.94
No savings at onset	0.35	1.43	0.06	0.21
Experience	-0.28	-0.53	-1.52	-2.51
Tenure	0.01	0.57	-0.01	-0.32
Tenure missing	-1.18	-2.80	-1.52	-2.83
Physical, heavy, stooping	0.03	0.13	-0.01	-0.02
Eyes, intense concentration	0.26	0.54	0.23	0.45
Pace set by others	-0.18	-0.92	-0.06	-0.24
Skill dealing with people	0.02	0.11	0.21	0.75
Decide pay of others	0.19	0.77	0.25	0.75
Professional [b]	-0.09	-0.17	0.19	0.34
Sales [b]	-0.03	-0.05	0.70	1.24
Clerical [b]	-0.22	-0.38	0.62	1.21
Service [b]	0.23	0.52	1.01	1.82
Craftsperson [b]	0.15	0.39	1.43	2.09
Laborer [b]	0.28	0.70	0.75	1.30
Military [b]	-0.19	-0.15	c	c
Occupation missing [b]	0.39	0.72	1.36	1.68
Agriculture [d]	1.11	1.64	c	c
Mining [d]	0.86	1.66	c	c
Manufacturing [d]	0.57	1.17	0.11	0.32
Transportation [d]	0.59	1.14	c	c
Retail, wholesale, finance [d]	0.62	1.20	c	c
Service [d]	c	c	-0.12	-0.34
Professional service [d]	-0.08	-0.16	c	c
Public administration [d]	-0.27	-0.44	c	c
Less than 5 employees [e]	0.02	0.03	0.99	2.09
Between 5 and 14 employees [e]	-0.66	-1.65	-0.34	-0.77
Between 15 and 24 employees [e]	0.05	0.10	-0.14	-0.24
Between 25 and 99 employees [e]	-0.69	-2.11	0.40	1.22
Between 100 and 499 employees [e]	0.01	0.04	0.33	0.98
Empoyer size missing employees [e]	-0.78	-3.26	1.27	0.57
Pension	-0.55	-2.07	0	0.01
Pension missing	0.56	1.13	1.08	1.87

Continued

Appendix Table B-8.
Continued

	Men		Women	
Variable	Coefficient	t-value	Coefficient	t-value
Union status	-0.19	-0.87	-0.03	-0.13
Union status missing	c	c	-2.48	-1.09
Result of accident at work	0.07	0.27	0.32	1.18
Caused by nature of work	0.14	0.69	-0.44	-1.81
Two health conditions [f]	0.03	0.15	0.26	1.03
Three health conditions [f]	0.09	0.27	0.47	1.55
Cancer [g]	1.04	1.69	1.22	2.81
Paralysis [g]	1.39	3.47	0.86	1.13
Circulatory [g]	0.83	3.26	0.27	0.97
Respiratory [g]	0.30	0.98	0.05	0.13
Endocrine, digestive [g]	0.39	1.32	0.50	1.59
Nuerological [g]	0.67	1.81	0.33	1.02
Emotional [g]	1.09	2.00	0.47	1.19
Miscellaneous[g]	0.79	2.20	0.62	1.60
Education	-1.23	-0.39	-2.86	-0.65
Age	3.93	2.21	5.98	2.82
Black [h]	0.48	1.92	0.41	1.54
Other[h]	0.14	0.50	0.06	0.16
SSA records missing	0.29	1.43	0.59	2.46
Time	0.15	0.13	0.53	0.45
Time squared	-0.23	-0.38	-0.18	-0.28
Variance of heterogeneity	0.77	0.93	0.75	0.79

SOURCE: Authors' calculations based on wave 1 of the HRS data.

NOTES: Means are in Appendix Table B-2. Onset of disability is defined as the year the health condition first began to interfere with the person's work. The sample includes 572 men and 469 women. The log-likelihood is 865.25 for men and 670.88 for women.

a. Reference category is no spouse at the onset of a disability.
b. Reference category is manager occupation at the onset of a disability.
c. Sample size of women is too small to estimate.
d. Reference category is service industry at the onset of a disability for men. Because of very small numbers in other industries, the reference group for women is all other industries.
e. Reference category is 500 or more employees working for the employer at the onset of a disability.
f. Reference category is one health condition at onset of a disability.
g. Reference category is a musculoskeletal condition at the onset of a disability.
h. Reference category is white race.

Appendix Table B-9.
Estimated probabilities of men and women applying for DI within 5, 10, and 15 years after the onset of disability

Variable	Men's probability of applying				Women's probability of applying			
	Within 5 years	Within 10 years	Within 15 years	Expected duration	Within 5 years	Within 10 years	Within 15 years	Expected duration
Outcome at sample means	0.440	0.651	0.734	8.808	0.360	0.600	0.763	9.349
Constant	0.048	0.053	0.052	-0.852	0.086	0.112	0.105	-1.645
State allowance rate [a]	0.074	0.088	0.087	-1.335	0.092	0.123	0.117	-1.768
Expected DI benefit [a]	-0.205	-0.232	-0.223	3.685	-0.110	-0.141	-0.132	2.106
Accommodation	-0.070	-0.076	-0.074	1.249	-0.082	-0.108	-0.102	1.569
Expected earnings [a]	0.027	0.031	0.029	-0.490	0.032	0.041	0.038	-0.615
Real earnings growth [a]	0.021	0.024	0.023	-0.376	-0.011	-0.014	-0.013	0.206
State unemployment rate [a]	0.032	0.036	0.035	-0.573	-0.087	-0.112	-0.104	1.667
Experience [a]	0.085	0.097	0.093	-1.532	0.112	0.144	0.134	-2.150
White collar job	0.231	0.261	0.251	-4.147	0.215	0.276	0.257	-4.112
Two health conditions	-0.131	-0.148	-0.142	2.354	-0.066	-0.085	-0.079	1.261
Three health conditions	0.034	0.038	0.036	-0.603	0.004	0.005	0.005	-0.081
Musculoskeletal	-0.045	-0.051	-0.049	0.804	-0.050	-0.065	-0.060	0.964
Cardiovascular	0.082	0.093	0.089	-1.470	0.128	0.164	0.153	-2.445
Education [a]	0.009	0.010	0.010	-0.163	-0.023	-0.030	-0.028	0.442
Age [a]	0.154	0.174	0.167	-2.767	0.118	0.152	0.141	-2.262
Married	0.066	0.074	0.071	-1.177	-0.015	-0.019	-0.018	0.281
Black	0.043	0.049	0.047	-0.776	0.113	0.145	0.135	-2.156
Other race	0.080	0.110	0.110	-1.690	0.030	0.040	0.040	-0.620
SSA record missing	0.100	0.130	0.140	-2.040	0.140	0.210	0.220	-3.070

SOURCE: Authors' calculations based on wave 1 of the HRS data.

NOTE: Onset of disability is defined as the year the health condition first began to interfere with the person's work.

a. Reference catategories are the same as in Appendix Table B-7. All dummy variables are measured as a change from the sample mean to a value of 1. Marginal effect is based on a 20 percent increase evaluated at the mean.

Notes

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[1] The retrospective data from the Health and Retirement Study provide two alternative starting points for the health condition reported in 1992: (1) when the condition first began to bother the respondent and (2) when the condition first began to interfere with the respondent's work. We use the first starting point because we assume that it is when respondents begin to reevaluate their participation in the workforce in light of that condition. However, we also report the results using the second starting point in Appendix B. The results for our policy variables are not sensitive to our choice of starting point. No economic or sociodemographic variables predict the difference between the two starting points.

[2] Bound and Burkhauser (1999) summarize the literature on the impact of public policy, economic factors, and the social environment on the decision to apply for DI benefits.

[3] See Kreider and Riphahn (2000) for another paper that examines factors that affect a woman's decision to apply for disability benefits and Kreider (1999a) for a paper that uses an alternative measure of wage uncertainty, namely wage growth.

[4] Gallichio and Bye (1980) conducted a more limited study, based on a common set of 1978 disability claims, that compares the level of disagreement among DI decisions across states with that among examiners within a single state. For cases classified as having limited information on which to base a decision, they found substantially more disagreement across

states than among examiners within a single state. For example, the level of disagreement across any two states in the study ranged from a low of 17 percent to a high of 36 percent and averaged 23 percent. The level of disagreement within a single state ranged from 6 percent to 23 percent and averaged 17 percent. Thus, states appear to administer the rules quite differently for cases that were incomplete and, by implication, not clear-cut. For cases classified as having complete information, the variation across and within states was similar.

[5] Previous research using state variations to test models was also unable to control for this potential problem. See Parsons (1991b) for a state-level analysis of the impact of allowance rates on DI applications. See Gruber and Kubik (1997) for an analysis of the impact of the allowance rates on labor supply.

[6] Kreider (1999a) uses estimated growth rates in earnings and benefits along with estimates in the variance of those growth rates to measure the impact of benefits on the decision to apply for DI. Kreider (1998, 1999b) uses variance of log income as a measure of risk. For the lognormal distribution, these measures are very highly correlated.

[7] Previous attempts to correct for bias resulting from an employer's choice to accommodate have not been successful. Charles (1996) constructed a theoretical model to identify the impact of employer accommodation on the decisions of randomly selected workers to leave their employer once their health began to affect their ability to work. His empirical estimates using HRS data, however, are implausibly larger than the estimates that do not correct for that bias. The result was inconsistent with his hypothesis. Burkhauser, Butler, Kim, and Weathers (1999) also attempt to correct for the bias using HRS data. However, they were only able to identify the model using nonlinearities in the probit equation, which is a relatively weak identification strategy. They also produced estimates that were larger than those not corrected for the bias. We do not attempt to correct for the potential bias here.

[8] Results using the year in which the condition first began to interfere with work are reported in Appendix Tables B-3 to B-9.

[9] In addition to using this approach, we used the entire sample of persons who responded to Question J123 and used the SSI amount for persons whose calculated PIA was below the SSI amount. The results were not substantively different.

[10] The Lewin Group, under contract with the Social Security Administration, prepared a public-use file that contains annual state allowance rates from 1974 to 1993. The state allowance rates from 1974 to 1979 are from Donald O. Parsons (1991b). The state allowance rates for 1980 through 1993 come from each state's Disability Determination Service. See Lewin Group (1995) for further details. Data for Alaska, Hawaii, and the District of Columbia are not available from 1974 through 1979. All 50 states and the District of Columbia are represented in the data from 1980 through 1993.

[11] The restricted state-level identifiers may be acquired by special permission from the HRS. Instructions for applying to use the data are on the Web at www.umich.edu/~hrswww. Additional permission is required to link the data with Social Security administrative records, and the link can only be performed at the HRS data enclave at the Institute for Social Research, University of Michigan.

[12] The program we use to estimate the PIA uses DI and SSI program rules for the entire time period as reported in the 1998 *Annual Statistical Supplement* to the *Social Security Bulletin*. We construct a respondent's average monthly wages for 1974 through 1978 and a respondent's average indexed monthly earnings for 1979 through 1993.

[13] Approximately 25 percent of respondents in our sample refused to allow their Social Security earnings history to be matched to the HRS data. In such cases, we assign the sample mean for the expected PIA for each year and add a dummy variable that indicates that the person did not allow their earnings history to be used. We followed the same procedure in our measure of expected earnings. It is possible that these refusals are not random. Burkhauser, Butler, Kim, and Weathers (1999) estimated selection-corrected earnings regressions based on information in wave 1 of the HRS. The inverse Mills ratio was not statistically significant.

[14] We considered two issues in constructing our expected earnings measure. First, Social Security earnings histories are censored at the Social Security taxable earnings maximum. Labor earnings above that level are not observed. We assumed lognormal distributions of earnings and estimated the earnings given the truncated lognormal distribution. Limited data available for untruncated earnings and extensive experience in labor economics support this method of adjusting for topcoding. A tobit model has also been commonly used to handle this problem in the disability literature (Bound 1989; Kreider 1999a). Second, expected earnings are not observed for workers who apply for benefits. An autoregression is used to predict earnings for such workers. The R-squared for the autoregression is 0.74 for men and 0.82 for women, implying that it has much greater explanatory power than the earnings equations previously used to handle this problem in the disability literature.

[15] Data on the state unemployment rate come from the Lewin Group public-use data file. The Lewin Group obtained those data from the Bureau of Labor Statistics for all 50 states and the District of Columbia. The data are merged to individual records using the restricted HRS state identifiers.

[16] Rupp and Stapleton (1995) use aggregate state-time data from 1988 through 1992 to show that a rise in the unemployment rate increased DI application.

[17] Parsons (1991a) did not include the state unemployment rate in his specification. Rupp and Stapleton (1995) replicated Parsons' study and included an additional specification with the state unemployment rate. Inclusion of the state unemployment rate, along with age effects, cut the estimated elasticity of DI application with respect to the state DI denial rate by one-half.

[18] Appendix Table B-3 shows descriptive statistics using the alternative starting point for the analysis. While the sample population using the alternative starting point is virtually the same, there are some small differences in the values. The

reason is that the year the work-limiting condition first began to bother the respondent occurred before the year the work-limiting condition first began to interfere with the respondent's job for about 30 percent of men and 33 percent of women. Nonetheless, as Appendix Table B-4 shows, the two onset years are the same or are only a few years apart for the vast majority of cases.

[19] Appendix Table B-5 shows the life-table estimates for men and women based on the year the condition first began to interfere with their ability to do their job. The risk of application is higher in the first three periods for men and in the first four periods for women following onset relative to our results in Table 3. Nonetheless, application does not immediately follow the onset of a disability when onset is measured at either the point at which the condition first began to bother the respondent or the point at which the condition first interfered with the respondent's work.

[20] These kernel density estimates can be thought of as bar charts that show the distribution of applicants across states.

[21] We find similar results using the year that the condition first began to interfere with work as the starting point for the analysis. However, for men the relationship between the state allowance rate and first application for DI benefits becomes more apparent. Appendix Table B-6 shows that the difference in the mass of the distribution above the intersection is larger and statistically different at the 5 percent level. For women, the difference is slightly smaller, but it is still statistically significant at the 10 percent level.

[22] The tables using the year the health condition first began to interfere with respondents' work as the year of onset yielded similar results for both men and women.

[23] The specification is similar to that used in Burkhauser, Butler, Kim, and Weathers (1999) but adds the initial state allowance and the state unemployment rate to their specification. It also includes an additional health measure for the presence of three or more conditions.

[24] This finding suggests that there may be some unobserved systematic differences between the group of women who allowed their SSA records to be matched to the HRS data and those who did not. To examine the impact of those differences, we estimated a model using the sample of women who allowed their SSA earnings histories to be used. The signs of the coefficients were the same as those reported here, and policy variables were statistically significant at the 5 percent level. The estimated marginal impacts were slightly larger using the sample of respondents who allowed their SSA records to be used. The results are available from the authors upon request.

[25] To test the robustness of the model, in Appendix Table B-7 we use the year the health condition began to interfere with work as the starting point of our analysis. No changes in statistical significance or the importance of policy variables occur. To further test the robustness of our model, in Appendix Table B-8 we add more controls for health and job characteristics. This specification does not affect the sign or significance of the effects of the policy variables.

[26] Appendix Table B-9 shows the marginal impact of variables for men and women using the year the condition first began to interfere with work as the onset year. The results are similar in magnitude.

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