Three Essays on Social Security Disability Insurance

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
(Economics)
in The University of Michigan
2011

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ACKNOWLEDGEMENTS

This dissertation would not have been possible without the help and support of many people.

My deepest gratitude is to my co-chair Dr. John Laitner, who shepherded me through graduate school from the beginning. During countless office hours, he patiently taught me how to develop ideas and how to transform them into academic research.

I am equally thankful to my co-chair Dr. John Bound for his great expertise and advice. His many comments, addressing both small details and conceptual questions, greatly helped me to structure my work and to improve upon my research and presentation skills.

Dr. Jeffrey Smith was always willing to talk through ideas and issues, whether professional or personal. His confidence in my work early on greatly helped me to persevere. I am also thankful to him for carefully reading and correcting many versions of my manuscript.

I am also grateful to Dr. Brian McCall for making even the most complex technical issue tractable and for providing both inspiration and hands-on support.

Most of this work was done at the Social Security Administration in Washington, DC. I am indebted to Dr. T. Lynn Fisher for guiding me through the process of obtaining permission to work at SSA. I would also like to thank Becky Bahlibi,

Francoise Becker, Dr. Paul Davies, Dr. Bill Davis, Thuy Ho, and Tom Solomon for their support.

Special thanks to the Boston Retirement Center for providing financial support for this research. I would especially like to thank Dr. Norma Coe and Dr. Matthew Rutledge for their support.

I am also grateful to the Urban Institute and to Dr. Timothy Waidmann for providing both office space and helpful guidance.

I would not have been able to live and work in Washington, DC without the support of Dr. Norma Nager.

I want to thank my co-workers and friends with whom I shared thoughts, ideas, and an office during all of the years. I especially would like to thank Dr. Wenjie Chen, Dr. Osborne Jackson, Owen Kearney, Dr. Boern Muetzel, Dr. Brian Rowe and Jessica Wyse.

My final and deepest appreciation is reserved for my family. I would especially like to thank my parents Monika and Josef (Ben) Lindner who always encourage me to pursue my goals, my dear brother Dr. Michael Lindner with whom I enjoy many inspiring conversations, and my wife Jessica Wyse, who took my hand to walk with me.

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From Working to Application: Documenting Employment Transitions of Applicants for Social Security Disability Insurance

1.1 Introduction

Social Security Disability Insurance (DI) provides monetary and medical benefits to 7.8 Million beneficiaries in 2009. Along with the strong increase in program participation since the early 1990s has come a renewed interest in understanding how economic and other factors influence application decisions. The purpose of the paper is to document the scope and nature of transitions from working to not working which occur before individuals apply for DI.

Three main findings emerge. First, the majority of applicants for DI experience a transition from being employed to being without work prior to their application. These employment transitions account for most of the observed income decline before application. Second, the majority of workers report either the onset of a work limitation or an illness or injury shortly before they become non-employed. And third, even though most non-employment episodes begin with a health shock, applicants typically do not move quickly onto DI. Furthermore, classifying these non-employment spells by beginning events reveals that search effort, UI take-up, and DI application success differ by reason of job loss. Similar differences can also

be found when comparing the first month of non-employment to the month where the individual applies for DI.

These results have important implications for our understanding of application decisions. Halpern and Hausman (1986) treat application decisions as a choice between applying for the program and working. Subsequent studies such as Kreider (1998, 1999) and Lahiri et al. (2008) have increased the degree of complexity, but maintained the premise that workers make a decision between applying for DI versus working. In contrast, Autor and Duggan (2003) and Bratsberg et al. (2010) recently emphasize that job loss prior to application for DI is an important factor influencing application decisions. This paper contributes to this line of research by analyzing beginning events and characteristics of non-employment spells before applications for DI occur. The results suggest that economic conditions at the beginning and during these spells may influence application decisions. Therefore, the decisions process of an individual at the verge of applying for DI might be better characterized as one of job search versus application for DI, where job opportunities, transfer income, and search intensity all could influence the decision to apply for DI. An example of this approach is provided by Lindner (2011), who analyzes how unemployment insurance benefits influence the decision to apply for DI of health-impaired, unemployed workers.

The article also contributes to our understanding of the effect of health shocks on employment and application for DI. Previous studies such as Benitez-Silva et al. (2004) show that onset of a severe work limitation drastically reduces the fraction of people who work. On the other hand, aggregate-level studies such as Rupp and Stapleton (1995) point out that DI applications are positively correlated with the unemployment rate, implying that bad economic conditions are an important reason why people apply for DI. The results of this paper suggest that these pathways are not mutually exclusive: most applicants do report a health shock

around the time they stop working, but they also do not immediately move onto DI.

This paper is also related to Burkhauser et al. (2004) and Bound et al. (2003). Burkhauser et al. analyze how the timing of applications depends on factors such as employer accommodations, but they do not consider transitions from working to being without work. Bound et al. document that applicants for DI or SSI buffer their pre- and post-application income losses with other income sources. This article uses data similar to theirs, but focuses on the role of prior employment transitions and circumstances at the beginning and during non-employment for application decisions.

The following section provides a brief overview of the DI program, followed by an explanation of the data used for this study. Section 1.4 documents transitions from employment to DI application and section 1.5 concludes.

1.2 Institutional Background

DI was enacted in 1956 to insure workers as well as their spouses and dependents against loss of earnings due to disabilities by providing monetary transfers and access to Medicare. In 1974, SSI for the Disabled and Blind was added as a second program aimed at disabled adults. For both programs, disability is defined as

> (...) the inability to engage in any substantial gainful activity by reason of any medically determinable physical or mental impairment which can be expected to result in death or which has lasted, or can be expected to last, for a continuous period of at least 12 months.[1]

[1]See See Title II of the Social Security Act, Section 223. [42U.S.C. 423], (d)(1)(A) (`http://www.socialsecurity.gov/OP_Home/ssact/title02/0223.htm`.)

In practice, whether a person can engage in substantial gainful activity is operationalized by an earnings threshold. This earnings threshold, which was $200 for the non-blind in 1975, has been raised sporadically to $700 by 2000. Since then, it has been adjusted for inflation, and as of 2009 has reached $1,000.

For both programs, initial applications are determined by a sequential five-stage procedure, which assesses the applicant's health impairment severity and work capacity.[2] While initial applications are processed relatively quickly, only a minority of applicants are accepted.[3] The appeal process itself has several stages, namely reconsideration, administrative law judge (where most appeals are decided), appeals board, and federal court. Applicants who appeal an initial denial have a high chance to be awarded benefits, but the appeals process can extend over several months, and often exceeds a year or more (Benitez-Silva et al., 1999).

While medical eligibility criteria are the same for both insurance programs, their non-medical eligibility criteria are somewhat different. Eligibility for DI requires a recent and relatively steady work history.[4] Eligibility for SSI does not stipulate this work history, but people must have income and assets below certain thresholds. Individuals can apply for both programs if they meet their respective non-medical requirements. About one quarter of applicants apply for both programs.

The DI program grew strongly during the 1960s and 1970s. In the mid-seventies, the Social Security Administration (SSA) tried to reduce the number

[2]See for instance Hu et al. (2001) for a description of the initial application process.

[3]For instance, in 2002, only about 37 per cent of all initial applications were accepted at the initial determination. About one-third of initially denied applicants appeal the decision (Szymendera, 2006).

[4]Specifically, workers need to be to be both disability-insured and fully insured in order to be eligible for DI benefits. Workers aged 31 or older are disability-insured if they have worked in Social Security covered employment during 20 of the 40 quarters prior to their date of disablement. They are fully insured if they have worked in covered employment for, on average, 1 out of every 4 quarters between the year they turned 21 and the year before the year in which they reached age 62 or became disabled.

of admissions by refining the regulation guiding decisions. In 1980, Congress passed further legislation which made it more difficult to receive benefits. As a result, award rates fell from 48.8 percent to 33.3 percent between 1975 and 1980. Widespread criticism led Congress to reverse its policies in 1984. These amendments increased the number of medical impairments which qualify for DI, and shifted the weight towards evidence provided by the claimant's own physician. Further liberalizations were implemented in 1988 and 1991. Since then, the number of DI beneficiaries has steadily increased.

Most applications for the two programs occur during economic downturns, when the unemployment rate is high (Rupp and Stapleton, 1995). This positive correlation between the unemployment rate and applications for DI has lead researchers to hypothesize that job loss is an important event causing many potential applicants to file an application (Autor and Duggan, 2003; Bratsberg et al., 2010). In what follows, the frequency and characteristics of transitions from employment to non-employment for DI applications are examined. Before doing so, the next section describes data used for this analysis.

1.3 Data

This study uses several Survey of Income and Program Participation (SIPP) panels which are matched to administrative records. The SIPP is a nationally representative sample of individuals 15 years of age and older of the civilian non-institutionalized population. The main objective of the SIPP is to provide accurate and comprehensive information about income and program participation of individuals and households in the United States. People are interviewed once every four months, called a wave, for two to four years. When sampling a new SIPP, the Census Bureau randomly groups people into four rotation groups. Starting

with the first rotation group, each subsequent rotation group is interviewed one month after the previous one. When interviewed, respondents are asked to provide information about the preceding four months, which are also called reference months. For this study, SIPP covering the period 1990 to 2004 are used.[5]

While the SIPP provides information on employment, demographic characteristics, and participation in transfer programs, it does not contain application dates and outcome decisions for DI. To overcome this limitation, the SIPP is matched to administrative records on DI applications and their respective award decisions using Social Security Numbers (SSN). Applications are identified through so-called 831 files. When a person applies for DI, an 831 file is opened. It subsequently tracks the application and initial determination.

While 831 files record applications including the reconsideration stage, they do not record subsequent appeals. In order to improve the accuracy of the application information, 831 files are augmented by the Master Beneficiary Records (MBR). These records contain complete application information including appeals for the latest disability application of an applicant. Earlier applications, however, are erased from the MBR records. For such applications, the application outcome can still be recovered with the help of the Payment History Update System (PHUS), which records who receives DI benefits. MBR and PHUS records are matched to 831 files using application and benefit start dates, respectively.[6]

Sample selection proceeds in several stages, as shown in table 1.1. From the universe of men and women between the age of 20 and 65, those who do not report

[5]These are: SIPP 1990, 1992, 1992, 1993, 1996, and 2001. Administrative records are currently only available until 2004, so the 2004 SIPP could not be linked to administrative data for the purpose of this study.

[6]In practice, dates of filing might differ for same applications in these files. Therefore, we matched records which were filed within 50 days. PHUS records are matched to 831 or MBR records if the benefit start date is within 100 days of the date an application decision has been reached.

their Social Security Number have to be disregarded since they cannot be linked to Social Security's administrative records. Next, civilians who apply for DI while being surveyed for the SIPP are selected. SSI applicants are kept in the sample only if they also apply for DI. For some of the panels, a wave is missing and they are disregarded as well. After these steps, 2,122 applicants for disability insurance remain in the sample.

Based on this sample, I also create spells of non-employment. For these episodes, only applicants who did not work at the time of application are considered. Furthermore, non-employment spells might be left-censored. Such spells are disregarded as well.[7] There are 984 applicants for which at least one complete spell of non-employment prior to DI application is observed. Only non-employment spells ending with an application are considered.

1.4 The role of employment transitions for DI applications

1.4.1 Scope of employment transitions

The analysis begins with employment and work limitation trends within 30 months before and after application for DI, using the panel of 2,122 applicants. Figure 1.1 presents the percentage of applicants who have reported a work limitation 30 months before and 30 months after applying for DI. The fraction of applicants reporting a work limitation increases steadily 30 to 10 months before application, and then accelerates during the last 10 months. At the month of application, 78.61 percent of all individuals report a work limitation. Afterward, the percentage still increases further, albeit at a small rate.

[7]For left-censored spells, the initial date of job separation can be reconstructed using SIPP's employment history module. However, other demographic information cannot be recovered in this way. Therefore, left-censored spells are not kept in the sample.

It is puzzling that not 100 percent of all individuals report a work limitation when they apply for DI, since a work limitation is necessary to qualify for the program. The work limitation question is not included in all waves for SIPP 1990 to 1993. For these surveys, some of the workers might not have the chance to express a newly occurred work limitation at the time they apply for DI. Repeating the trend in reported work limitation by application status separately for SIPP 1990 to 1993 and SIPP 1996 and 2001, as shown in figure 1.2, reveals that this survey design problem can explain half of the gap. For SIPP 1996 and 2001, 89.90 percent of all workers report a work limitation when they apply for DI. Still, 10 percent apply without having reported a work limitation. Non-response cannot account for this gap since less than 0.5 percent of all responses for this question were imputed. Left-censoring might be part of the explanation. Using SIPP 1996 and 2001, the months observed before application for those with and without work limitation at time of application are compared. The average difference in observed months prior to application is 3.21 months. However, most applications do not occur right after start of the SIPP survey. The average months observed before application is 16.51 for individuals without a work limitation at time of application and 19.74 months for individual with a work limitation at time of application.

Turning to the employment rate of applicants, figure 1.3 shows the average employment rate 30 months before and after application. The employment rate starts at about 77.50 percent, decreases to 62.94 percent 10 months before application, and then declines strongly to 28.28 percent during the month of application. Therefore, most applicants for DI experience a transition from working to not working shortly before applying for DI. Loss of employment can also explain most of the observed income decline prior to application. Figure 1.4 shows first income of applicants in the 15 months before application, and then decomposes the in-

come change into income change due to job loss as well residual income change.[8] The change in income due to the change in employment tracks the overall income decline very closely until the last 4 months before application.

Reported work limitations increases strongly in the 10 months before DI application. During the same time, employment rates drop strongly. To see more clearly how employment is influenced by the onset of a work limitation, figure 1.5 presents monthly employment rates of applicants, but this time centered around the first month a work limitation is reported. The employment rate drops at the month the work limitation begins, but there is also further decline during the months following onset of a work limitation. The employment decline at the onset of a work limitation is much less pronounced than the employment decline from 60 percent to 15 percent reported by Benitez-Silva et al. (2004). Since they use the Health and Retirement Study (HRS), the difference in the employment decline at onset of a work limitation is most likely due to different ways the work limitation question is worded. In the SIPP, a respondent is classified as being health impaired if he or she answers yes to the following question: "Does ... have a physical, mental or other health condition that limits the kind or amount of work ... can do?". In the HRS, by contrast, a respondent is only classified as being health impaired if he or she answers yes to both of the following questions:

[8]Decomposition of personal income is done as follows: first, income in period t can be expressed as

$$I_t = I_t^W \cdot P_t^W + I_t^N \cdot P_t^N \quad ,$$

where I_t denotes average personal income of all people at time t, I_t^W is average personal income of all people who work, P_t^W is the fraction of people working, and the last two terms are the average personal income and fraction of people not working, respectively. Using Δ for changes between two time periods, the change in income can then be expressed as:

$$\Delta I_t = \Delta I_t^W \cdot \overline{P_t^W} + (\overline{I_t^W} - \overline{I_t^N}) \cdot \Delta P_t^W + \Delta I_t^N \cdot \overline{P_t^N} \quad .$$

From the decomposition, the income decline due to changes in the earnings and unearned income of people working can be calculated by applying the first expression of the right-hand side to subsequent periods, while the income decline due to changes in the fraction of people working can be calculated by applying the second expression of the right-hand side to subsequent periods, as shown in figure 1.4.

"Do you have any impairment or health problem that limits the amount of paid work you can do? If so, does this limitation keep you from working altogether?" In addition, individuals are interviewed only every other year in the HRS. Therefore, recall bias which clumps together reported dates of health and employment changes is likely to be more severe for the HRS.

Together, these trends show that most applicants start reporting a work limitation and stop working before applying for DI. Less clear is whether a majority of these job losses occur because of the onset of a work limitation, or whether other economic factors such as getting laid off play a role as well. Furthermore, episodes of non-employment could be very different in terms of spell length or search behavior depending on the reason why individuals stop working. To address these questions, I now turn to the spells of non-employment preceding applications.

1.4.2 Analysis of Non-Employment episodes

In what follows, the sub-sample of applicants with fully observed non-employment episodes which end in application for DI are used. In all tables, fields with fewer than 10 observations are masked with XXX to avoid disclosure risk.

Spell duration: Table 1.2 reports the hazard rate to DI application and the fraction of non-employed workers who have not yet applied for DI for the first 12 months of non-employment spells. The hazard rate is also shown in figure 1.6. The hazard rate to DI application is remarkably high for the twelve months considered. While it is higher in the first four months as compared to later months, and peaks in the second month at 0.24, it remains above 0.10 for all of the twelve months except for the 9^{th} month. Clearly, applicants do not immediately apply for DI as soon as they become jobless. More than 30 percent of them do not apply before

being without a job for six months or more.

Classification of beginning events: In order to identify whether a health shock or other factors contribute to the observed job loss, a hierarchical classification scheme for beginning events is developed. Several variables are used to identify beginning events. Table 1.3 shows variables identifying beginning events.

The first group contains applicants those spells begin because of an illness or injury. Two sets of questions in the SIPP provide this information. First, an individual who is absent from work may report an illness or injury as the reason for not being at work.[9] Second, for SIPP 1996 and 2001, workers who stop working during a wave or who do not work during the entire wave may report an injury or illness as reason why they do not work.

The second group of applicants are those who report a work limitation shortly before they stop working. Two definitions are used, a broad and a narrow one. For the broad definition, a work limitation must be reported at least once during the first month of non-employment or during the 8 months before the the non-employment spell begins, but not earlier than that. The time window for the narrow definition is 4 months. The multiples of 4 are used because most changes in reported health and employment occur between waves and not within, which is a manifestation of the seam bias. Months with no information about a work limitation are treated as months without work limitation. Such missing values occur for the 1990 to 1993 SIPP because these surveys only include questions about health in selected modules.

The true onset of a work limitation might not be observed since the SIPP

[9]Months during which a worker is absent from work are considered as months of full employment, and therefore are not directly included in the sample of non-employment spells. However, if a worker is first absent from work and then stops working during a wave, then the wave contains information why the worker was absent before the non-employment spell.

follows respondents for only 2 to 4 years. As a result, too many non-employment spells are classified as starting with the onset of a work limitation, for two possible reasons. First, only 8 (4) or fewer months before job loss may be observed. If a work limitation is reported for all of these months, then the non-employment spell is still assumed to begin with the onset of a work limitation, even though the true, unobserved onset of the work limitation could have occurred several months before the first SIPP interview. Second, work limitation episodes prior of being surveyed for the SIPP are not recorded. Such earlier episodes, if observed, would result in an earlier work limitation onset.[10]

If a spell does not start because of an injury or illness or because of a work limitation, then six more groups are distinguished: layoff, laid off, discharged, quit, retirement, and unknown or other events. Layoffs are temporary interruption of work, while being laid off refers to permanent termination of employment due to business conditions, economic conditions, or other reasons which are not the employee's fault. Workers might also get discharged, or they may quit or retire from work. These groups are identified through various questions. An individual who stops working during a wave can chose one of these events as a reason. Furthermore, a layoff can be identified if the individual is first absent from work. For SIPP 1996 and 2001, a non-employment spell can also be classified as layoff or retirement if the individual is out of work during the entire wave.

Finally, some non-employment spells do not fit into any of these categories. Some spells begin with other events such as taking care of children or going to school. Other have an unknown beginning events. Such unknown beginning events

[10]For instance, suppose that a respondent had three health episodes: the first marks a work limitation, the second no work limitation, and the third episode again a work limitation. If the person is first interviewed during the second episode, then the beginning of the third episode would be considered as the onset of a work limitation, even though the true onset occurred earlier, namely with the first episode. In such a case, a non-employment spell starting right after the third episode would be wrongly classified as belonging to spells which were caused by the onset of a work limitation.

primarily exist because before the SIPP 1996, only respondents who stop working *during* a wave are asked why they stop working. Unfortunately, most individuals report that an employment change occurs *between* waves. Furthermore, contingent workers are not asked why they stop working.

Table 1.4 presents frequencies of beginning events. For the broad definition of work limitation onset (first row of category 1.1 in the table), 18.76 percent of all non-employment spells begin due to an illness or injury, and another 33.08 percent of all spells begin due to a work limitation. Less than 25 percent of all non-employment spells are classified under the next five categories, and 23.83 percent of all spells cannot be classified or are other events. When the narrow definition of work limitation onset is used, 26.08 percent of all spells begin in this way (first row of category 2.1).

Illness or injury as beginning event can be much better identified starting with the 1996 SIPP. The next two rows show frequencies of beginning events by two groups, SIPP 1990 to 1993 and SIPP 1996 and 2001. For the second group, almost half of all spells begin with an injury or illness. By contrast, only 2.52 percent of all spells can be classified in this way for the SIPP 1990 to 1993. By contrast, work limitation accounts for 40.11 percent of all beginning events in the SIPP 1996 and 2001, but for less than 20 percent in the SIPP 1990 to 1993. Not known or other events drop from 32.65 percent to 7.22 percent. Of the few cases left in this category for the SIPP 1996 and 2001, half are other events, such as taking care of children or not being interested in working. The other half are contingent workers, who are not asked why they stop working.

Altogether, health shocks are the predominant beginning event. Presumably, the most accurate results are from the SIPP 1996 and 2001. For these, at least two thirds of all spells begin with an illness, injury, or the onset of a work limita-

tion. This result seems surprising given that figure 1.5 does not exhibit a sharp employment decline when a work limitation is first reported. However, employment primarily declines at the onset of a work limitation and during the ensuing months, and much less so during other months.

Given the low number of job separations due to layoff, being laid off, quit, discharged, and retirement, it is of interest to ask what an upper bound for these other reasons is. To do so, beginning events are re-classified by treating illness, injury, and work limitation as the lowest categories. The results are shown in table 1.4 as categories 1.2 and 2.2 for the broad and narrow definition of work limitation onset, respectively. Focusing on results from SIPP 1996 and 2001, at most 40 percent of all non-employment spells start with a beginning event other than a health shock. The different types of health shocks together still account for the majority of beginning events.

Spell characteristics by beginning events: The next table addresses the question whether non-employment spells differ by beginning events. Table 1.5 presents for the different beginning events spell length, waiting time between application and award for DI, application success chance, whether individuals searched, UI eligibility and take-up percentages, and education level. Since layoffs and discharges occur very infrequently, they are combined with workers who are laid off into a new category called job loss. For the table, the hierarchical classification with illness or injury and work limitation as the highest categories is used.

As shown in the first column, people who cite an illness or injury apply the quickest, have the highest chance of receiving benefits, and very rarely search. There are only few individuals in this category who receive UI benefits (the number cannot be disclosed), albeit more than 90 percent of them qualify for UI based on

monetary eligibility criteria. This group of applicants represents the most clear-cut case of people who experience a health shock, leave employment, and move onto DI. Still, the average non-employment duration of 4.56 months indicates that even this group of people does not immediately apply for DI as soon as they stop working.

The second columns of table 1.5 shows corresponding characteristics for non-employment spells which start with the onset of a work limitation. Compared to illnesses and injuries, workers included in the broad work limitation category remain 0.9 month longer without work before applying for DI, have a 4.84 percent lower application success probability, and are more than twice as likely to engage in job search. Almost 18 percent of them also receive UI benefits. These characteristics do not change much if the more narrow definition is used.

Non-employment spells after quits are remarkably similar to non-employment spells starting with a work limitation. In contrast, the category comprising other reasons of job loss is characterized by a long non-employment duration, low application success probability, high search effort, and a high percentage of workers who are eligible for and who take up UI benefits. These workers also have the lowest percentage of high-school graduates and college attendees. Finally, retirement spells have the longest duration but a short waiting time and high application success chance.[11]

Health shocks and spell characteristics across panels: As shown above, illnesses and injuries are much better identified in the SIPP 1996 and 2001 as compared to earlier surveys. Conceivably, the more accurate classification of such

[11]Individuals with an unknown beginning event are by far the least likely to be eligible for UI benefits. This group consists of contingent workers and workers who stop working for other reasons such as taking care of children or going to school. Presumably, many of these workers do not qualify for UI benefits on monetary grounds.

beginning events also translates into different spell characteristics for these two SIPP groups. Table 1.6 presents spell characteristics of non-employment episodes by health shocks and SIPP survey groups. Spells starting with a work limitation after 1996 are now even more similar to non-employment spells starting with a job loss from the previous table. By contrast, characteristics for non-employment spells starting with an injury or illness change little. These results underscore that a reported illness or injury is a much stronger indicator for a quick transition to DI application as compared to only a reported work limitation, and that the additional questions in the SIPP 1996 and 2001 are valuable in identifying this group of DI applicants.

Beginning versus ending of spells: The economic situation of non-employed workers considered here might also change over the course of their non-employment spell. However, comparisons over the course of non-employment episodes is complicated by the fact that individuals leave the sample as they apply for DI. Therefore, any changes over non-employment duration confounds changes individuals might experience with changes in the composition of individuals.

To alleviate this problem, table 1.7 simply compares the first month of non-employment with the month of application. Individuals who apply during the first month are represented in both groups. Nevertheless, the table reveals some notable differences between the first and last month. The percentage of people searching drops by more than 8 percentage points, while the percentage of people reporting a work limitation increases by 10 percentage points. The latter result is similar for SIPP 1990 to 1993 and SIPP 1996 and 2001. It is consistent with Sullivan and Wachter (2009), who find elevated mortality rates among older workers who lose their job as compared to similar workers who remain employed. Household income declines slightly. The fraction of individuals receiving UI benefits

increases slightly, which seems to be counter-intuitive. However, further inspection of UI recipient reveals that a higher percentage of individuals receives them in the second and third month than in the first. Apparently, not all individuals who take up UI benefits do so in the first month of non-employment. Food stamps recipient increases strongly, whereas Worker's Compensation decreases slightly. The percentage of people receiving temporary sickness benefits remains fairly constant.

1.5 Conclusion

This article documents transitions from employment to DI application. Most applicants do not work at the time of application, and instead experience a transition from working to not working before applying for DI. Focusing on non-employment spells reveals that most applicants experience an illness, injury, or the onset of a work limitation shortly before or at the time of job loss. However, most of these applicants do not immediately apply for DI, but only after several months without work. Applicants who stop working because of other reasons do not apply for an even longer time, and show the typical behavior of a person searching for a job.

These results indicate that the period of time during which individuals are without work before they apply for DI plays an important role in the application process. While health problems often contribute to job loss and subsequent application for DI, most applicants do not move directly to DI application. Rather, many applicants first take up unemployment insurance benefits or engage in job search. These findings suggest that many applicants follow a sequential decision process where application for DI is not necessarily their first choice.

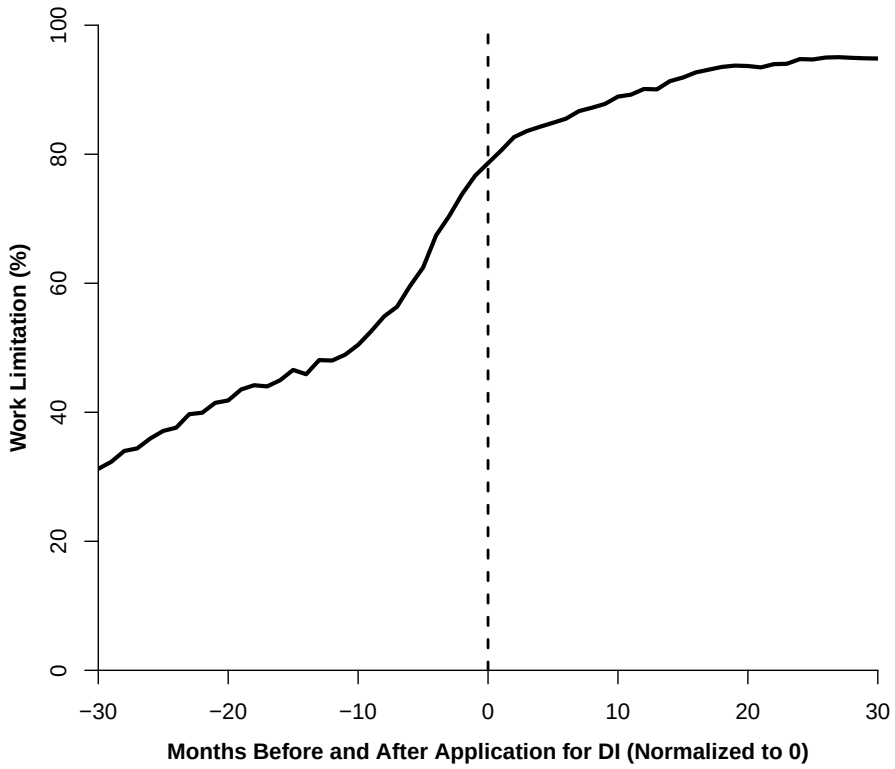

Figure 1.1: Onset of work limitation, by months relative to first application for DI.
Source: SIPP panels 1990-2001 matched to administrative records

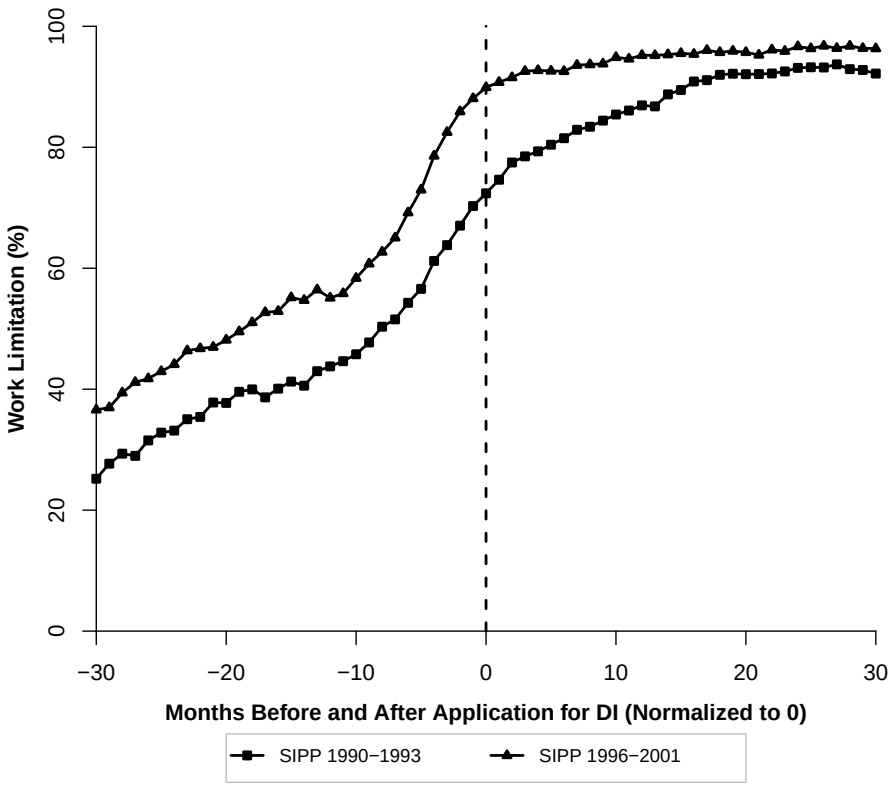

Figure 1.2: Onset of work limitation, by months relative to first application for DI and SIPP groups.
Source: SIPP panels 1990-2001 matched to administrative records

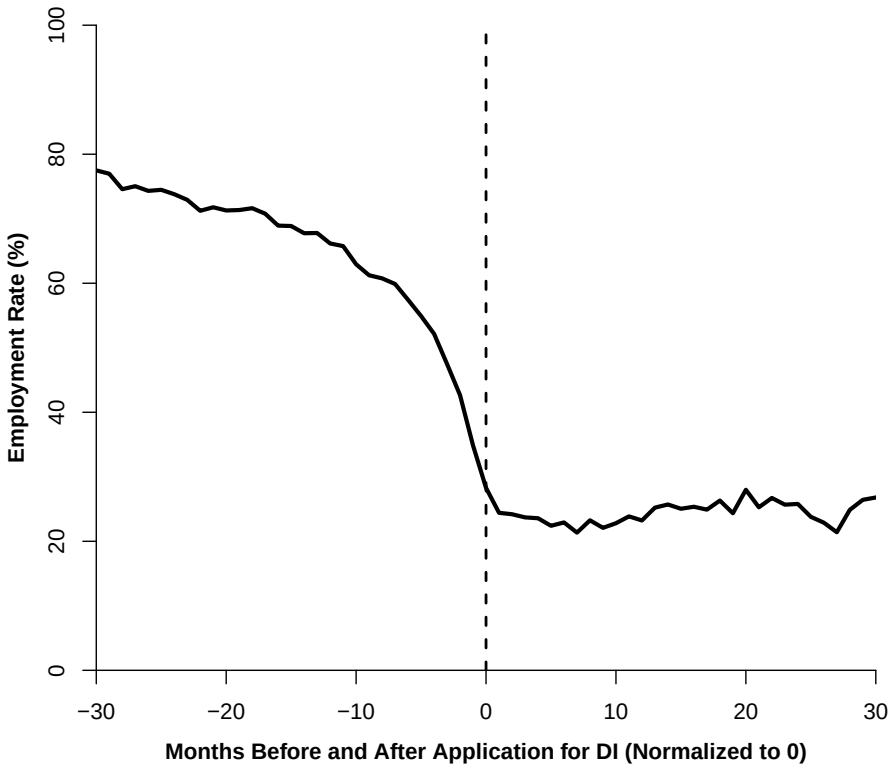

Figure 1.3: Employment rate, by months relative to month of first application for DI.
Source: SIPP panels 1990-2001 matched to administrative records

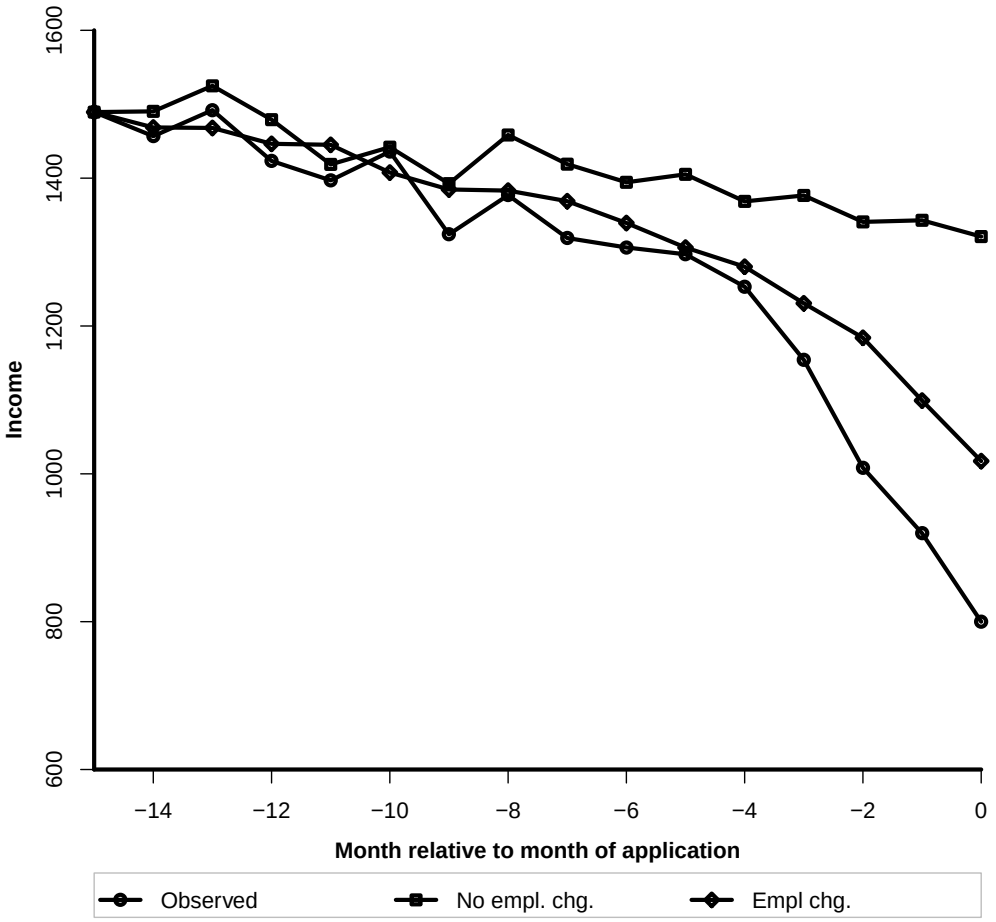

Figure 1.4: Decomposition of personal income into income change due to change in employment ("Empl chg.") and other income change ("No empl. chg."), by months relative to month of first application for DI.
Source: SIPP panels 1990-2001 matched to administrative records

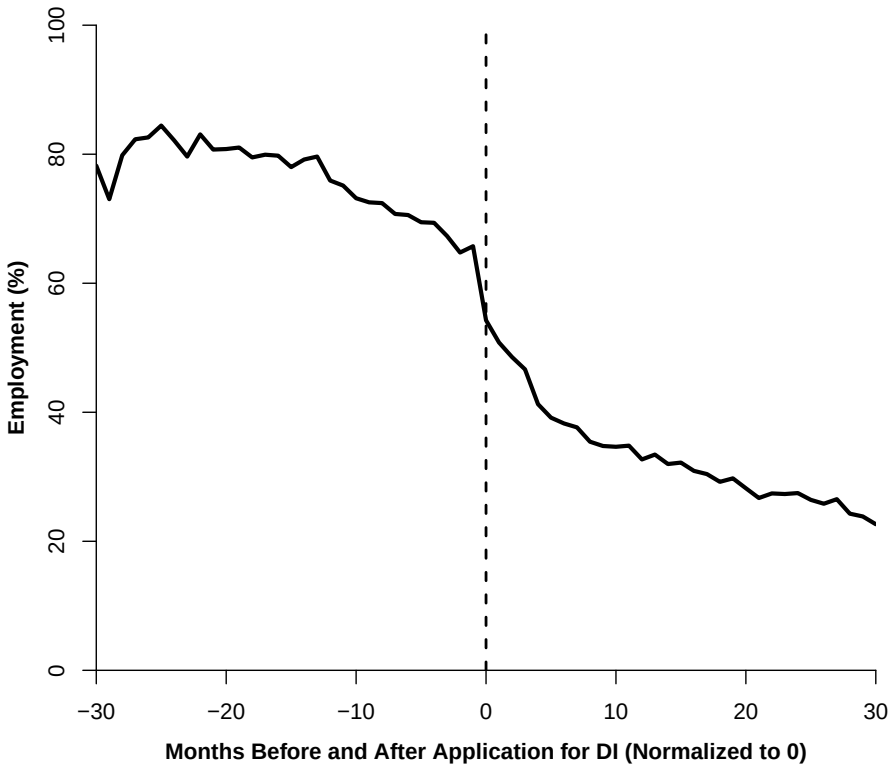

Figure 1.5: Employment rate, by months relative to onset of work limitation. *Source: SIPP panels 1990-2001 matched to administrative records*

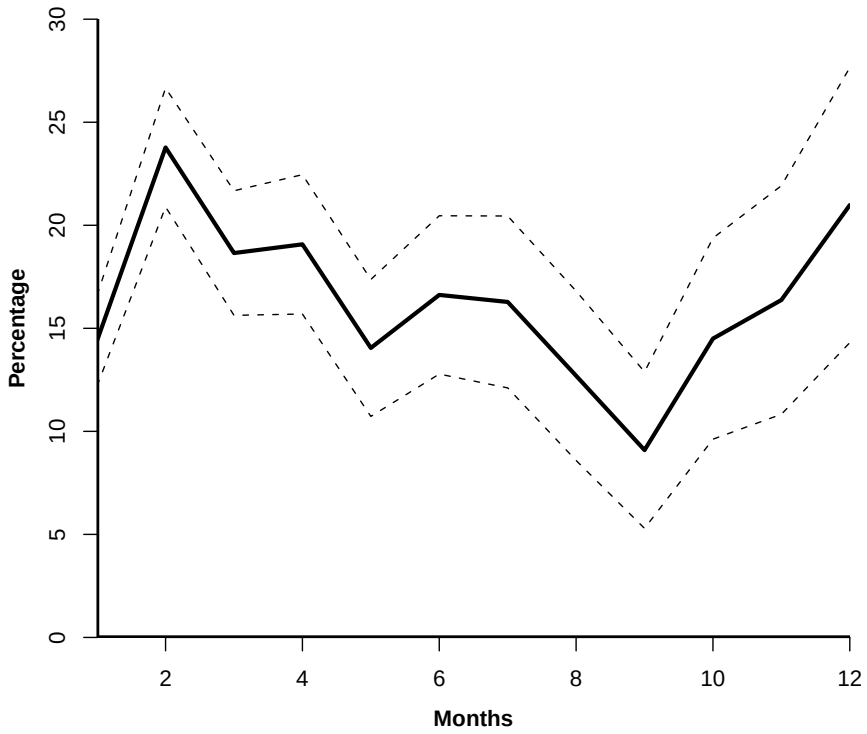

Figure 1.6: Hazard rate to DI application.
Source: SIPP panels 1990-2001 matched to administrative records

Table 1.1: Sample Selection

Selection Step	**Individuals**	**Individiuals for Non-employment Spells**
People 20-65	258130	258130
Disclose SSN	189533	189533
Civilians	187096	187096
No SSI	181244	181244
Application for DI observed	2470	2470
No incomplete panel	2122	2122
Not working while applying	—	1518
No left-censored non-employment spell	—	984

NOTE. – The table shows unweighted population numbers for selection steps. Data source: SIPP panels 1990-2001 matched to administrative records. See text for details.

Table 1.2: Hazard and Survival Rate for Non-Employment Spells

Month of non-employment	**Hazard rate (x100)**	**Survival probability**
1	14.39	85.61
2	23.78	65.26
3	18.65	53.09
4	19.08	42.96
5	14.05	36.92
6	16.62	30.79
7	16.28	25.78
8	12.70	22.50
9	9.09	20.46
10	14.50	17.49
11	16.37	14.63
12	20.98	11.56

NOTE. – Data source: SIPP panels 1990-2001 matched to administrative records.

Table 1.3: Classification of Beginning Events

Information Source	**Illness / Injury**	**Work Limitation**	**Layoff**	**Laid off / Discharged / Quit**	**Retirement**
Absent from work	1990-2001		1990-2001		
Stop working during wave	1996-2001		1990-2001	1990-2001	1990-2001
Not working during wave	1996-2001		1996-2001		1996-2001
Work limitation		1990-2001*			

NOTE. – Information sources indicates questions used to identify beginning events. Cell numbers represent SIPP surveys.

Absent from work: Respondents who report being absent from work are asked about the reason of not being at work.

Stop working during wave: Respondents who report stop working during a wave are asked about the reason of not working anymore.

Not working during wave: Respondents who report not working during wave are asked about the reason of not working during that time.

Work Limitation: Respondents are asked the following question: "Does ... have a physical, mental or other health condition that limits the kind or amount of work ... can do?"

* SIPP 1990-1993: Wave 1 and selected topical modules only. SIPP 1996 and 2001: all waves.

Table 1.4: Beginning Events: Frequency

Percentages	Illness / Injury	Work Limitation	Layoff	Laid off	Discharged	Quit	Retirement	Not known / Other
1. Broad definition for work limitation onset								
1.1 Injury/Illness and work lim. as highest hierarchical categories								
All surveys	18.76	33.08	2.61	7.25	2.39	8.50	3.57	23.83
SIPP 1990-1993	2.52	40.11	XXX	9.02	2.36	10.20	2.18	32.65
SIPP 1996-2001	49.36	19.84	5.74	3.92	2.43	5.30	6.19	7.22
1.2 Injury/Illness and work lim. as lowest hierarchical categories								
All surveys	17.23	18.99	4.67	10.58	4.11	14.90	5.69	23.83
SIPP 1990-1993	XXX	26.48	XXX	13.70	3.92	18.43	3.70	32.65
SIPP 1996-2001	49.36	4.88	11.68	4.71	4.46	8.26	9.43	7.22
2. Narrow definition for work limitation onset								
2.1 Injury/Illness and work lim. as highest hierarchical categories								
All surveys	18.76	26.08	2.61	7.91	2.59	10.04	4.19	27.81
SIPP 1990-1993	2.52	31.04	XXX	10.03	2.36	11.93	2.85	38.31
SIPP 1996-2001	49.36	16.74	5.74	3.92	3.01	6.49	6.72	8.02
2.2 Injury/Illness and work lim. as lowest hierarchical categories								
All surveys	17.23	15.01	4.67	10.58	4.11	14.90	5.69	27.81
SIPP 1990-1993	XXX	20.81	XXX	13.78	3.92	18.43	3.70	38.38
SIPP 1996-2001	49.36	4.07	11.68	4.71	4.46	8.26	9.43	8.02

NOTE. – Data source: SIPP panels 1990-2001 matched to administrative records. All cell numbers represent percentages. Person-level population weights are used. Fields with fewer than 10 observations are masked with XXX to avoid disclosure risk. The first row in each part shows percentages for SIPP surveys. The second and third row in each part shows percentages for SIPP 1990 to 1993 and SIPP 1996 and 2001, respectively. See text for details concerning the broad and narrow definition for work limitation onset and for the hierarchical classification scheme.

Table 1.5: Beginning Events

	Illness / Injury	Work Limitation	Job Loss	Quit	Retirement	Not known
1. Broad definition for work limitation onset						
Spell Length	4.56	5.46	8.17	5.59	8.42	6.14
Waiting Time	6.31	6.30	6.15	6.13	6.01	6.07
Appl. Success	68.28	63.44	53.68	62.38	67.69	58.57
Searched during spell	11.29	26.06	75.79	31.56	XXX	26.67
Unemployment Rate	5.12	6.53	6.40	6.39	5.67	6.56
UI eligible	91.22	92.39	95.62	93.00	95.36	87.24
UI take-up	XXX	17.92	56.96	XXX	XXX	15.11
HS Graduate	79.85	66.28	55.11	70.96	78.81	65.85
College	24.33	22.30	19.90	24.05	40.49	23.47
2. Narrow definition for work limitation onset						
Spell Length	4.56	5.33	8.13	5.52	8.81	6.00
Waiting Time	6.31	6.18	6.12	6.44	5.54	6.21
Appl. Success	68.28	61.76	54.62	63.98	68.31	59.99
Searched during spell	11.29	25.85	75.64	30.03	XXX	26.14
Unemployment Rate	5.12	6.47	6.41	6.45	5.78	6.59
UI eligible	91.22	93.63	95.02	91.66	96.04	87.28
UI take-up	XXX	17.88	56.32	XXX	XXX	14.41
HS Graduate	79.85	67.24	56.51	73.74	77.90	63.30
College	24.33	20.86	20.25	29.39	36.50	22.73

NOTE. – Data source: SIPP panels 1990-2001 matched to administrative records. Spell length and waiting time are expressed in months, the other cells represent percentages. Having searched during the spell, UI eligibility, and UI take-up refer to the whole spell. Person-level population weights are used. Fields with less than 10 observations are masked with XXX to avoid disclosure risk. See text for an explanation of the broad and narrow definition for work limitation onset and for the hierarchical classification scheme.

Table 1.6: Beginning Events (Health Shocks) by Panels

	SIPP 1990-1993		SIPP 1996-2001	
	Illness / Injury	**Work Limitation**	**Illness / Injury**	**Work Limitation**
Spell Length	3.49	5.61	4.67	4.92
Waiting Time	8.45	6.42	6.11	5.83
Appl. Success	67.90	68.27	68.31	45.03
Searched	XXX	21.98	9.50	41.60
Unemployment Rate	6.50	6.87	4.99	5.23
UI take-up	XXX	14.63	XXX	30.45
UI eligible	89.98	92.61	91.34	91.54
HS Graduate	XXX	61.23	81.84	85.51
College	XXX	23.52	23.21	17.67

NOTE. – Data source: SIPP panels 1990-2001 matched to administrative records. Spell length and waiting time are expressed in months, the other rows show percentages. Searched and UI recipient refers to the whole spell. Person-level population weights are used. Fields with less than 10 observations are masked with XXX to avoid disclosure risk. See text for an explanation of the broad and narrow definition for work limitation onset and for the hierarchical classification scheme used.

Table 1.7: Comparison of beginning and ending months

	First month	**Last month**
Searched	22.41	16.09
Work Limitation	70.79	80.89
Household income	1872.53	1650.96
UI recipient this month	8.66	9.21
Food Stamp recipient this month	8.25	14.02
Temp. Sickness recipient this month	7.23	7.71
Worker's Compensation recipient this month	8.45	7.09

NOTE. – Data source: SIPP panels 1990-2001 matched to administrative records. Spell length and waiting time are expressed in months, the other rows show percentages. Income is expressed in 1990 dollars. Person-level population weights are used for all statistics. Fields with less than 10 observations are masked with XXX to avoid disclosure risk.

CHAPTER II

How Does Unemployment Insurance Affect the Decision to Apply for Social Security Disability Insurance?

2.1 Introduction

Unemployment insurance (UI) and Social Security Disability Insurance (DI) are two of the primary insurance systems in the United States. They both provide cash benefits to people out of work. At the beginning of 2010, about 830,000 disabled workers who were not on DI were unemployed, and potentially eligible for both programs (Joint Economic Committee, 2010). Nevertheless, no current study has investigated how the availability and benefit levels of UI influence a workers' decision to apply for DI.

This paper analyzes how UI take-up and benefits affect the decision to apply for DI among health impaired workers who have lost their jobs. Using a model of job search and application for DI, I can show that UI benefits may influence the DI application decision in two opposing ways. On the one hand, more generous UI benefits decrease the immediate need for DI benefits, and thereby reduce the likelihood that these workers apply for DI. On the other hand, UI benefits provide potential applicants with income support during the application process, which might be lengthy. Therefore, more generous UI benefits facilitate the application

for DI. Given these competing hypotheses, the overall effect of UI benefits on the application for DI remains ambiguous. Furthermore, a long waiting time for DI benefits, coupled with the relatively short duration of UI benefits, may reduce the magnitude of these channels towards zero. Concerning the UI take-up decision, the act of claiming benefits itself might deter jobless workers from applying for DI. For instance, UI claimants may worry that they are supposed to be able and available for work, and therefore will not be eligible for DI benefits after picking up UI benefits.

To empirically test these hypotheses, I construct spells of non-employment from the Survey of Income and Program Participation (SIPP) covering the years 1990 to 2004. SIPP surveys are matched to Social Security DI application and awards records in order to identify applications and their outcomes. Monthly unemployment insurance benefit amounts (MB) are imputed for each worker using state unemployment laws and prior earnings history. Focusing on workers who are at risk of applying for disability insurance, I jointly estimate the hazard to disability insurance application and UI take-up, allowing for correlated random effects across these decisions. Results show that higher monthly UI benefits reduce the hazard to DI application. Therefore, the insurance effect dominates. The effect is sizable for those on UI. With respect to the UI take-up decision, claiming UI benefits does not reduce the hazard to DI application in the absence of random effects. However, when random effects are included, claiming UI benefits significantly reduces the hazard to DI application. The random effects are positively correlated, which indicates that the unobserved components of transaction costs associated with claiming UI benefits and applying for DI are positively related.

Studying how UI take-up and benefits influence the decision to apply for DI contributes both to the literature on disability and on unemployment insurance.

Previous models of DI application such as those devised by Halpern and Hausman (1986), Kreider (1999) or Lahiri et al. (2008) have primarily focused on how long-term income flows affect application decisions. Potential applicants presumably consider long-term income prospects when deciding whether or not to apply for DI, since DI beneficiaries often stay in the program for several years. Black et al. (2002) find supportive evidence that permanent and not short-term earning shocks due to the coal boom and bust influence DI enrollment. However, their study does not directly assess whether short-term income shocks affect application decisions for DI, and they do not focus on the preceding transition from working to not working. In contrast to these studies, Lando et al. (1979) and Rupp and Stapleton (1995), among others, find a positive correlation between the rate of unemployment and applications for disability insurance. As economic downturns are often brief episodes, these findings suggest that short-term income shocks might influence the application decision for DI as well.

This study addresses the question whether short-term cash income influences application decisions by estimating how one major short-term determinant of income for jobless workers, unemployment insurance, affects the application decision for DI of workers who have a work limitation and who experienced a recent job loss. Thereby, it builds on recent work by Autor and Duggan (2003), who emphasize that people with work limitations who still have some work capacity do not consider applying for DI while employed. Once they lose their jobs, however, they may apply for DI.[1] The link between job loss and application for disability insurance is of particular interest since it concerns workers at the margin of applying for DI, those who do not consider applying when employed, but do so after losing their jobs. Presumably, the application decision for these marginal

[1]Bratsberg et al. (2010) use administrative files from Norway to identify the causal effect of job loss on application for DI, and find that a large proportion of disability insurance claims can be directly attributed to job displacement.

applicants is sensitive to current income. However, marginal applicants who lose their jobs not only suffer from income loss, but also experience declining health (Sullivan and Wachter, 2009), difficult long-term employment conditions (Bound and Burkhauser, 1999), and are more likely to pass the initial earnings screening, which precludes DI applicants from engaging in any substantial work. It is therefore not possible to conclude from correlations of job loss and subsequent application for DI that short-term income shocks influence application decisions. By connecting panels of the Survey of Income and Program Participation to administrative data on DI claims, this paper is able to show that UI benefits have a negative effect on applications for DI.

This finding highlights that jobless marginal applicants are credit-constrained, since they would otherwise not apply for DI benefits because of insufficient current income.[2] Thereby, this paper relates to studies which emphasize the beneficial role of unemployment insurance in consumption (Gruber, 1997) or search behavior (Chetty, 2008) of unemployed workers. This study expands on this literature by suggesting that UI benefits may also affect the long-term labor supply for a subgroup of jobless people with health problems. This is so because successful applicants for DI almost always withdraw from the paid labor force for life.

The sensitivity of DI applications with respect to short-term income shocks also relates to recent literature on productivity risks and insurance programs (see Low and Pistaferri, 2010a,b). The common insight is that social insurance programs offer only partial insurance against the productivity shocks they are designed for. Therefore, changes to one social insurance program induces spill-overs to other insurance programs, as found for instance by Duggan et al. (2007) for DI and retirement in the United States and Borghans et al. (2010) for DI and other social

[2]While families generally are able to smooth consumption with respect to earnings changes (Dynarski and Gruber, 1997), many unemployed workers are credit-constrained and therefore have limited resources to smooth consumption (e.g. Card et al., 2007).

assistance programs in the Netherlands. The results from this study suggest that some workers apply for DI benefits as insurance against income shocks for which the UI program is designed for, either because UI benefits are insufficient, or because they do not claim UI benefits to begin with. Therefore, providing short-term cash benefits to such marginal applicants could be an attractive policy to reduce applications for DI. However, such policies can only be effective if the population of potential DI applicants in need of short-term cash benefits can be targeted. For instance, back-of-the-envelope calculations suggest that increasing UI benefits for all UI claimants is not likely to be cost effective, due to the small number of UI claimants who are likely to apply for DI.

The next section provides an overview of the two insurance systems. It is followed by the theoretical discussion (section 2.3). Section 2.4 presents the econometric approach, data, and results, and conclusions are given in section 2.5.

2.2 The Unemployment and Disability Insurance Systems

This section provides an overview of significant provisions of the Social Security Disability Insurance (DI) and the Unemployment Insurance (UI) programs.

2.2.1 Social Security Disability Insurance (DI)

Social Security Disability Insurance (DI) is the largest federal insurance program in the United States directed towards non-elderly disabled adults. In 2009, about 2.8 Million people applied for DI benefits, and 7.8 Million people were recipients of DI benefits.[3] Total benefits paid in 2008 amounted to $95 billion dollars. By comparison, Temporary Assistance for Needy Families accounted for $17 billion in

[3]See SSA's Publications at `http://www.ssa.gov/OACT/STATS/dibStat.html`.

2009. Beneficiaries are primarily older, less educated workers. For instance, Autor and Duggan (2003) report that in 1999, more than 20 percent of men and more than 15 percent of women aged 55 to 64 without high-school degrees received DI benefits.

DI was enacted in 1956 to insure workers, as well as their spouses and dependents, against loss of earnings due to disability by providing monetary transfers and access to Medicare. In 1974, SSI for the Disabled and Blind was added as a second program, aimed at disabled adults. Only applications for DI are considered here since SSI applicants have very weak labor force attachment and therefore are unlikely to be able to take up UI benefits. For both programs, disability is defined as

> (...) the inability to engage in any substantial gainful activity by reason of any medically determinable physical or mental impairment which can be expected to result in death or which has lasted, or can be expected to last, for a continuous period of at least 12 months.[4]

Medical eligibility criteria and the application determination process are the same for both insurance programs, but their non-medical eligibility criteria are somewhat different. Eligibility for DI requires a recent and relatively steady work history.[5] Eligibility for SSI does not stipulate this work history, but people must have income and assets below certain thresholds. Individuals can apply for both programs if they meet all respective non-medical requirements.

Initial applications are determined through a sequential five-stage procedure.

[4]See See Title II of the Social Security Act, Section 223. [42U.S.C. 423], (d)(1)(A) (`http://www.socialsecurity.gov/OP_Home/ssact/title02/0223.htm`.)

[5]Specifically, workers need to be to be both disability-insured and fully insured in order to be eligible for DI benefits. Workers aged 31 or older are disability-insured if they have worked in Social Security-covered employment during 20 of the 40 quarters prior to their date of disablement. They are fully insured if they have worked in covered employment for, on average, one out of every four quarters between the year they turned 21 and the year before the year in which they reached age 62 or became disabled.

First, applicants must not have engaged in substantial gainful activity (SGA) since disability onset, where SGA is defined as earning above a threshold.[6] Transfer income, such as UI benefits, is not considered for this earnings screen. The next four steps determine whether the health condition is severe (step 2), whether it is included in the list of disabling conditions (step 3), and, if not, whether the person can do their previous work (step 4) or any other type of work (step 5).[7] While the initial determination of claims is processed relatively quickly, about two-thirds of them are declined (Szymendera, 2006). About one-third of initially denied applicants appeal the decision, and two-thirds of appeals are successful for the claimant. However, appeals often persists for a year or more.

In addition to the waiting time between application and determination of the claim, Social Security's rules and regulations also stipulate a five-month minimum waiting period between disability onset and first benefit payment.[8] This minimum waiting period in combination with the SGA requirement mentioned above may pose a problem to workers who have recently lost their jobs. If they earned above SGA before job loss, they need to claim that their disability occurred simultaneously with losing their employment. In that case, they will have to wait for five months before receiving DI benefits. One possible solution to this dilemma is the so-called unsuccessful work attempt.[9] If applicants changed or stopped their work due to the impairment, they can earn above SGA for up to six months without losing eligibility. This clause might allow jobless workers to date their disability onset earlier than the time the job loss occurred. To what extent the five-month

[6]The amount is $1000 per month for the non-blind, and $1,640 for the blind in 2010. For a list of past SGA levels see `http://www.ssa.gov/OACT/COLA/sga.html`.

[7]See http://www.ssa.gov/dibplan/dqualify5.htm for a description and Hu et al. (2001) for an analysis of the initial determination.

[8]See Title II of the Social Security Act, Section 223. [42 U.S.C. 423], (c)(2) (`http://www.socialsecurity.gov/OP_Home/ssact/title02/0223.htm`).

[9]See Code of Federal Regulations, Title 20 – Employee's Benefits, Chapter III – Social Security Administration, Part 404, Section 1574 (`http://www.socialsecurity.gov/OP_Home/cfr20/404/404-1574.htm`)

waiting period binds is hard to gauge from regulations alone. It is an interesting empirical question on its own which has not been addressed yet. Section 2.4 provides evidence that some DI beneficiaries received their first DI benefit payment within five months after job loss.

DI benefits are calculated in the same way as retirement insurance benefits. After calculating the Average Indexed Monthly Earnings (AIME) from past earnings, a piecewise linear formula is applied to obtain DI benefits, which is also called the Principal Insurance Amount (PIA). The PIA is a concave function of past earnings, i.e., workers with low past earnings are reimbursed a higher fraction of their past earnings than workers with high past earnings. DI benefits are substantial: the average wage earner in 2008 would receive more than $1,500 in DI benefits per month, which is about 43 percent of average earnings in that year. Appendix 2.6 details the computation of the PIA.

2.2.2 Unemployment Insurance (UI)

The unemployment insurance system was established as part of the Social Security Act of 1935. It is a federal-state partnership to provide short-term cash benefits to people who lost their jobs through no fault of their own. As such, the number of claims varies strongly with the business cycle. For instance, the number of claims doubled from 3 million to 6 million between June 2008 and June 2009.

Unemployed workers are eligible for unemployment benefits if they fulfill all monetary and non-monetary eligibility criteria. Monetary entitlement requires recent and sufficiently high wage earnings. All states except Massachusetts consider the first 4 of the last 5 completed calendar quarters preceding the filing of a claim as the base period, i.e. the period for which a claimant's eligibility is

determined.[10] Wages during the base period must exceed a threshold set by the states.

Non-monetary eligibility criteria address the initial reason for job separation, and for ongoing claims, whether the claimant is able, available and seeking work. Concerning reasons for separations, workers must have lost their job through no fault of their own, i.e. either involuntarily, or voluntarily but with good cause. Common good cause provisions include an illness. Therefore, a worker who left a job because of a health impairment can still claim UI benefits. In some states, claimants also remain eligible if they become ill or disabled after filing their UI claim, as long as they do not refuse suitable work.[11] Concerning able and available provisions, most states consider filing a claim and registering for work at a public employment office as sufficient evidence. Unemployed workers may also be monitored and considered not available for work if they refuse job offers. Some states also require evidence that UI recipients actively seek work.[12] Workers who do not meet such requirements get their benefits reduced.

Each state uses a different formula to determine the weekly benefit amount of UI claimants. Benefit formulas generally specify a minimum and maximum benefit amount, as well as a replacement ratio – typically 50 percent – of past wage earnings within these boundaries. The majority of states stipulate a week of waiting, during which the claimant, while still eligible, does not receive any benefits. Workers may also receive extended benefits during times of high unemployment, which are regulated by the Federal-State Extended Unemployment Compensation Act of 1970. Extended benefits in a state are "triggered" if the state's unemploy-

[10]Massachusetts uses the four quarters preceding a claim. Some states also consider periods closer or further away from the filing date if the claimant does not fulfill eligibility criteria for the regular base period.

[11]These are Alaska, Delaware, Hawaii, Idaho, Maryland, Massachusetts, Montana, Nevada, North Dakota, Tennessee, and Vermont.

[12]New York, for instance, requires claimants to document which employers they have contacted (NYDL, 2010).

ment rate exceeds certain thresholds.[13] In such cases, unemployment benefits are extended by up to 13 weeks for unemployed workers after their regular benefits end. In addition, Congress may enact emergency extended benefits for all states on an ad-hoc basis. There have been eight such extensions, with the latest three from July 1992 to June 1993, March 2002 to December 2003, and the current period, which started in July 2008.

To summarize, this overview of rules and regulations for DI and UI show that the two programs are not mutually exclusive. The criteria for disability (DI) and ability to work (UI) differ enough that workers with performance limitations — especially those at the margin of applying for DI — may be considered not able to perform substantial gainful activity under the DI program, while they could be considered as able to work for UI purposes.[14] Receiving UI benefits also does not forfeit eligibility for DI, since such transfer income is not considered for the earnings screen.

The primary reason why UI benefits might not affect the decision to apply for DI is the timing of benefits. UI benefits are normally paid for only up to six months. On the other hand, the often lengthy waiting time and five-month minimum waiting period imply that DI benefits are often only paid several months after applications are submitted. To understand how UI benefits can affect the application decision for DI, and how the timing of benefit payments influences this decision, the subsequent section develops a model of job search and DI application.

[13]Specifically, there are three conditions under which extended benefits are paid. First, if the state's rate of insured unemployed workers (IUR) — the average weekly individuals filing regular claims divided by average monthly covered employment for the specified period — exceeds 5 percent for the past 13 weeks and had increased by more than 20 percent as compared to the average IUR of the corresponding 13 weeks of the past two years. Second, if a state's IUR had exceeded 6 percent over the last 13 weeks. Third, if the average seasonally adjusted rate of total unemployment in a state for the last 3 months equals or exceeds 6.5 percent, and the average rate of seasonally adjusted total unemployment in the state for the 3-month period equals or exceeds 110 percent of such average rate for either (or both) of the corresponding 3-month periods of the preceding 2 calendar years.

[14]To my knowledge, the respective agencies also do not communicate about ongoing claims.

The model also allows me to discuss whether the decision to take up UI benefits itself may affect the application decision for DI.

2.3 A Theory of Job Search and Application for DI

In this section, I analyze a model of job search and application for DI. The model features failures in credit markets so that jobless workers cannot borrow or save. I first describe the optimal search and DI application behavior, and then discuss the role of UI benefits in the decision to apply for DI. Finally, the role of UI take-up in the decision to apply for DI is discussed.

2.3.1 Optimal search and application for DI

Consider a discrete-time setting in which a worker is in the labor force until retirement age T. All periods are measured in months. The worker discounts future utility with factor β. Suppose that the worker initially has a job, but loses it at age τ_0. Each month $t = 1, ...$ without work, the worker chooses search effort s. Let $p(s_t)$ be the probability of finding a job in period t if the worker searched with effort s_{t-1} during the previous month. The function p is strictly concave in search effort s. I make the following assumptions to simplify the analysis: (i) the worker takes the job offer, which eliminates reservation wage choices[15]; (ii) there is no subsequent job destruction; and (iii) wage earnings w_t remain fixed from the period t the worker becomes re-employed until retirement.

Besides searching, the worker may also apply for disability insurance with

[15]Higher unemployment insurance increases unemployment duration, which either could increase subsequent wage earnings because of better match quality, or decrease earnings if there is a stigma effect to longer search. Empirically, Card et al. (2007) find no evidence that higher UI benefits have a discernible effect on subsequent wages. The analysis therefore treats wages as fixed.

application effort a.[16] After applying, the worker learns each month first about a job offer, and then whether the application has been determined, which occurs with probability q. Conditional on a decision being made, the worker is accepted into the program with probability $\alpha(h)$. Better health h decreases the chance of being accepted. If granted benefits, the worker receives disability benefits d. For simplicity, I further assume that (i) health does not change over time, (ii) DI beneficiaries remain in the program until retirement, and (iii) rejected applicants cannot reapply for DI.

The worker can claim UI benefits with effort e_u at the beginning of the first month after job loss. Monthly income without UI benefits is normalized to zero, and $b > 0$ while UI benefits are paid, for a duration of B months. UI benefits are paid whether the worker receives DI benefits or not. In what follows, only the scenario where claiming UI benefits is optimal is considered. The decision to take-up UI benefits is analyzed in section 2.3.4.

To begin with the optimal decision problem, the value of becoming employed at time t is[17]

$$V_t^e = \sum_{j=0}^{T-\tau_0-t} \beta^j \left[u(w_t) - e_e(h)\,, \right] \tag{2.1}$$

where $u(\cdot)$ is the strictly concave period utility function, and $e_e(h)$ is the effort of

[16] These application costs include filling out forms, attending an interview by phone or in person, and providing medical records. It is plausible that most costs of applying for DI are in the form of non-monetary effort since applicants need not pay for their medical examination.

[17] At time t, the worker is of age $(\tau_0 + t - 1)$, where τ_0 is the age of job loss. Since heterogeneity in age is not considered, the subsequent analysis treats non-employment duration t as the sole state variable.

working, which depends negatively on health h. Similarly, the value of receiving disability insurance at time t is

$$V_t^d = \sum_{j=0}^{T-\tau_0-t} \beta^j u(d + b \cdot I_{t\leq B}) \,, \tag{2.2}$$

where $I_{t\leq B} = 1$ if $t \leq B$ and zero otherwise, and the effort of being on disability insurance is normalized to zero. As discussed in the previous section, DI beneficiaries may also collect UI benefits, but the theoretical results would not change substantially if they could not. The value of being a rejected applicant at time t is defined recursively as

$$V_t^r = u(b \cdot I_{t\leq B}) - s_t^r + \beta p_{t+1}^r V_{t+1}^e + \beta(1 - p_{t+1}^r) V_{t+1}^r \,, \tag{2.3}$$

where s_t^r is the optimal search effort of a rejected applicant at time t which results in a probability $p_{t+1}^r(s_t)$ of finding employment in period $t+1$. Optimal search effort is determined by the first-order condition

$$1 = p'(s_t^r)\, \beta\, (V_{t+1}^e - V_{t+1}^r) \,.$$

The first-order condition states that the optimal level of search effort is chosen to equate marginal search costs of 1 with the marginal value of searching.

The worker's value of searching and not applying for DI at time t, conditional on not having applied for DI yet, is

$$V_t^s = u(b \cdot I_{t \leq B}) - s_t^s + \beta p_{t+1}^s V_{t+1}^e + \beta(1 - p_{t+1}^s) V_{t+1}\,, \tag{2.4}$$

where s_t^s is the optimal search intensity at time t and V_t is the value of non-employment at time t if not having applied for DI yet.

Finally, the value of applying for DI at time t is

$$\begin{aligned} V_t^a = u(b) - (s_t^a + a) + \beta p_{t+1}^a V_{t+1}^e + \\ \beta(1 - p_{t+1}^a)\left[q\alpha V_{t+1}^d + q(1-\alpha)V_{t+1}^r + (1-q)\tilde{V}_{t+1}^a\right], \end{aligned} \tag{2.5}$$

where $\tilde{V}_t^a = V_t^a + a$, since the worker has to incur application effort a only at the time of application, and search effort does not depend on non-monetary costs. Equation (2.5) shows that applying for DI is a lottery over future income.

Workers who have not yet applied for DI or are in the process of applying for DI choose optimal search intensity as determined by the respective first-order conditions:

$$\begin{aligned} 1 &= p_t'^s \, \beta \, (V_t^e - V_t) \\ 1 &= p_t'^a \, \beta \, (V_t^e - q(\alpha V_t^d + (1-\alpha)V_t^r) - (1-q)\tilde{V}_t^a) \end{aligned}$$

Given value functions and optimal search effort, the Bellman equation for the

optimization problem, which defined the value V_t of non-employment at time t of a worker who has not yet applied for DI can be stated as follows:

$$\begin{aligned} V_t &= \max\{V_t^s, V_t^a\} = \\ &= \max\{u(b) - s_{t+1}^s + \beta p_{t+1}^s V_{t+1}^e + \beta(1-p_{t+1}^s)V_{t+1}\,, \\ &\qquad u(b) - (s_{t+1}^a + a) + \beta p_{t+1}^a V_{t+1}^e + \\ &\qquad\qquad \beta(1-p_{t+1}^a)\big[q\alpha V_{t+1}^d + q(1-\alpha)V_t^r + (1-q)\tilde{V}_{t+1}^a\big]\big\}\,. \quad (2.6) \end{aligned}$$

Since optimal search intensity is higher if the net value of searching is higher, it follows directly that $s_{t+1}^r \geq s_{t+1}^s > s_{t+1}^a$ if application for DI is optimal at time t. The worker searches less when applying for DI, since the expected net value from searching is lower. Rejected applicants search the most, since $V_{t+1}^r \leq V_{t+1}$. Consequently, $p_{t+1}^r \geq p_{t+1}^s > p_{t+1}^a$.

2.3.2 The effect of higher UI benefits on the decision to apply for DI

To understand the channels through which UI benefits affect the decision to apply for DI, consider a \$1 increase in the benefit level b in period $t+1$ only on the value of not applying for DI at time $t < B$:

$$\frac{dV_t^s}{db} = \beta(1-p_{t+1}^s)u'(b)\,. \quad (2.7)$$

The increase in UI benefits increases the value of not applying in period t, since the worker might have to consume UI benefits in period $t+1$. Next, consider the effect of the same increase in UI benefits on the value of applying for DI at time t:

$$\frac{dV_t^a}{db} = \beta(1 - p_{t+1}^a)[\alpha q u'(d+b) + (1-\alpha q)u'(b)]\,. \tag{2.8}$$

Combining these two equations shows the effect of a \$1 increase in the UI benefit level b on the net value of applying for DI, $V_t^a - V_t^s$:

$$\frac{d(V_t^a - V_t^s)}{db} = \beta(1 - p_{t+1}^a)[\alpha q u'(d+b) + (1-\alpha q)u'(b)] - \beta(1 - p_{t+1}^s)u'(b) \tag{2.9}$$

Equation (2.9) shows that higher UI benefits affect the net value of applying through two distinct channels. The first one is the insurance channel. Application for DI increases expected income in period $t+1$. Since the utility function is strictly concave, it follows that $\alpha q u'(d+b)+(1-\alpha q)u'(b) < \alpha q u'(b)+(1-\alpha q)u'(b) = u'(b)$. In other words, an increase in UI benefits increases both the expected value of applying and not applying for DI. However, since DI applicants might receive DI benefits, their expected value increases less than non-applicants. Therefore, a \$1 increase in UI benefits decreases the net value of applying for DI. The second channel is a search effort effect. Since $p_{t+1}^a < p_{t+1}^s$ if applying is optimal at duration t, an applicant is less likely to become re-employed. Therefore, the net value of applying for DI increases in UI benefits through different search effort for those

who apply for DI. Put differently, a worker with low UI benefits would prefer not to apply for DI because applicants search less, and are therefore more likely to depend on UI benefits in the near future.

Whether higher UI benefits increase or reduce the net value of applying for DI depends on which of the two channels dominates. Proposition 1 states this result formally.

Proposition 1: A \$1 increase in UI benefit b at period $t+1$ decrease the net value of applying for DI in period $t < B$ iff

$$\alpha q \left(\frac{u'(b) - u'(d+b)}{u'(b)} \right) > \frac{p^s_{t+1} - p^a_{t+1}}{1 - p^s_{t+1}} \,. \tag{2.10}$$

Multiple periods of UI benefits: In reality, UI benefits are paid up to six months, or even longer during times of extended benefits. Therefore, a change in UI benefits affects the value of applying for DI during multiple periods. The result from proposition 1 essentially remains the same, as shown in appendix 2.7.1. The main difference to proposition 1 is that higher UI benefits also affect the value of being a denied applicant. Since denied applicants search the most, applying for DI benefits increases the probability of being dependent on UI benefits in the near future, but may decrease it later in the case of a denied application.

2.3.3 Institutional barriers

As mentioned in section 2.2, UI benefit duration and the waiting time until DI benefits are paid might affect the magnitude of the effect of higher UI benefits on the decision to apply for DI. First, consider the effect of a longer waiting time.

From the first-order conditions, it is evident that p_t^a decreases if q increases, both directly and indirectly through a higher value $\tilde{V}_{t+1}^a$ of an ongoing application. Search effort p_t^s also decreases in q, but only through V_{t+1}. Therefore, as the success probability becomes small, or the waiting time becomes long, p_t^a increases towards p_t^s. Intuitively, if there is little chance of receiving disability insurance, an applicant wants to search with the same intensity as if not applying. As a consequence, the search effort effect becomes small. Moreover, if q is very small, the insurance effect is negligible as well: from equation (2.9), it can be seen that $\alpha q u'(d+b) + (1-\alpha q)u'(b) \approx u'(b)$ in this case. Together, both effects get small as α or q get close to zero, and $dV^a/db \approx dV^s/db$. In words, a longer waiting time reduces the magnitude with which both channels operate, since it is less likely that the jobless worker will receive any DI benefits in the near future. As a consequence, the net effect also becomes negligible. Appendix 2.7.2 provides a formal proof that the net effect converges to zero as q approaches zero.

Figure 2.1 illustrates the effect of changes in the waiting time on the strength of how UI benefits affect the decision to apply for DI.[18] For the baseline scenario, the model is simulated for an application success probability of $\alpha = .6$, an application processing probability of $q = .6$, and an UI benefit duration of six months. For these values, the difference between the value of applying for DI and not applying at all for the first month of the non-employment spell is taken for UI benefits ranging from 1 to 5. The differences are normalized by the difference for $b = 1$. As can be seen, the insurance effect dominates for the selected parameter values, since the difference decreases in b. The model is then simulated again for a longer waiting time, where $q = .3$. As can be seen from figure 2.1, the effect of higher UI benefits on the net value of applying for DI is still negative, but less strongly

[18]The model is parametrized as follow: $\beta = .99$; $T = 500$; $a = 1$; $d = 7$; $w = 10$; $e = 1$; $b_0 = .1$; $B = 26$ weeks; $p = \sqrt{s/(50\max(s))}$; $s \,\epsilon\, [0;30]$, and $\alpha = .6$ and $q = .6$ for the baseline scenario.

than for the baseline scenario.

Duration of UI benefits has the same effect as the waiting time. If benefit duration is small, then any changes to UI benefits only affect income for the next several weeks, with little effect on the value of applying for DI relative to the value of no applying. For instance, higher UI benefits in period t do not change the value of applying versus not applying for period t. Figure 2.2 illustrates this intuition, using the same parametrization as above. The effect of higher UI benefits on the value of applying for DI relative to not applying is weaker for a benefit duration of only 3 months as compared to a benefit duration of 6 months.

Together, a long waiting time for first DI payments in combination with a short payment window for UI benefits imply that UI benefits are unlikely to affect the decision to apply for DI. Intuitively, by the time DI benefits are first paid, UI benefits have already stopped, and higher or lower UI benefits have little to no effect on the application for DI. Conversely, if there is overlap in the timing of UI and DI payments, UI benefits can influence the decision to apply for DI. To what extent benefit payments overlap is an empirical question which will be addressed in section 2.4.3.

2.3.4 UI take-up decision

The discussion so far has focused on how higher UI benefits may effect the decision to apply for DI. However, workers who have lost their job must first claim UI benefits in order to receive them. The decision whether or not to take up UI benefits might affect the decision to apply for DI as well. As discussed in section 2.2, claiming UI benefits does not necessarily jeopardize an application for DI. However, people who claim UI benefits might still worry that it reduces their

chances of a successful DI application. To see this, it is assumed for simplicity that no UI claimants are rejected. Suppose that the (perceived) application success probability depends on whether the person has claimed UI benefits: $\alpha(UI) < \alpha(No\ UI)$. Clearly, claiming UI benefits would then reduce the net value of applying.

Introducing the decision to claim UI benefits also suggests correlated take-up and DI application behavior due to correlated application costs. Such application costs include the act of filling out forms or making telephone calls, as well as any discomfort or social stigma involved with these applications. Other studies have shown that these costs, especially transaction costs, are important determinants of take up rates (see Currie, 2004 : for an overview). Therefore, it is plausible that correlated transaction costs also play an important role in the UI take-up and DI application decision. For instance, a person might be more or less timid about being dependent on transfer programs, in which case UI take-up and application for disability insurance are positively correlated. Formally, this example would imply that UI take-up costs e_U and application costs a for applying for DI are positively correlated. A worker with high e_U is then also more likely to have high application costs a, and will therefore be less likely to claim UI benefits and apply for DI as compared to an observationally identical worker with low costs of claiming UI benefits and applying for DI.

Summary and empirical implications: The above discussion suggests several links through which UI benefits might affect the decision to apply for DI. Claiming UI benefits in itself could reduce applications for DI if people worry that it diminishes their application chances, or if they have to search more than they would like to as applicants. For UI claimants, higher UI benefits might reduce applications for DI since both programs provide cash benefits. However, it is also possible that higher

UI benefits increase applications for DI because of lower search effort by DI applicants. Furthermore, institutional factors for both programs may reduce any effect of UI benefits on DI application to zero. The next section empirically assesses whether there is a discernible effect of UI benefits, which channel dominates, and whether the UI take-up decision affects applications for DI as well.

2.4 Empirical Analysis

2.4.1 Estimation Strategy

The objective of the empirical analysis is to estimate how UI take-up and benefit amount affect the decision to apply for disability insurance. To bridge from the theoretical model to the empirical specification, a latent value approach is used. To begin, suppose that the latent net value of applying for DI depends on observed and unobserved characteristics in the following linear form:

$$V_t^a - V_t^s = \log(\lambda_t^{\mathbf{0}}) + \mathbf{x_t^{D\prime}}\beta^D + \mathbf{UI}\,\gamma + \mathbf{MB}\delta_1 + (\mathbf{MB}\cdot\mathbf{UI})\,\delta_2 \; + \log(\zeta_r^D) - \varepsilon^D\,, \quad (2.11)$$

where t is the month of non-employment duration, $\log(\lambda_{\mathbf{t}}^{\mathbf{0}})$ a duration-specific constant, $\mathbf{x_t^D}$ are covariates influencing the disability insurance application, **UI** is a dummy variable equals to one if the person received unemployment insurance for at least one month, **MB** is the monthly benefit amount of unemployment insurance, ζ_r^D is a location point for type r of an unobserved heterogeneity distribution with R types of individuals, and the error term ε^D measures random shocks to the net value of applying for DI.

The unobserved location points are a semi-parametric random effects specification, assumed to be uncorrelated with observed characteristics or the error term. This approach was first advocated by Heckman and Singer (1984) as a solution to the problem that parameter estimates from single-risk hazard models with random effects are very sensitive to ad-hoc choices about the random effects distribution. McCall (1996) applied the semi-parametric specification to a correlated risk model. In the context of this study, the location points can be thought of as a measure of the application effort or eligibility for DI, which is unobserved to the econometrician, but may vary systematically across the population.

The latent net value of applying for UI is assumed to be linear in its parameters as well. Since most of the people who take up UI do so in the first period, the net value for UI take-up is specified for the first month of duration as follows:

$$V_1^U - V_1^o = \mathbf{x}_1^{\mathbf{U}\prime}\beta^U + \mathbf{MB}\,\delta_3 + \log(\zeta_r^U) - \varepsilon^U\,, \tag{2.12}$$

where V^U is the value of taking up UI, V^o is the value of not taking up UI, $\mathbf{x_1^U}$ are covariates for the UI take-up decision at the first month of unemployment, **MB** is the monthly UI benefit amount, and ζ_r^U is a location point for type r for unemployment insurance take-up. As in equation (2.11), ζ_r^U can be interpreted as unobserved costs of, or eligibility for, UI take-up. The error term ε^U measures random shocks to the net value of UI take-up. It is assumed that ζ^D and ζ^U might be correlated, but ε^D and ε^U are not.

Equations (2.11) and (2.12) can be used to demonstrate why endogeneity of UI needs to be addressed. For simplicity, suppose that we could observe the net value of DI application and UI take-up, and therefore be in the position to estimate

equation (2.11) via OLS. Assume further that there are no other covariates $\mathbf{x^D}$ and $\mathbf{x^U}$. Then, the least-square estimate of γ can be expressed as follows:

$$\hat{\gamma} = \gamma + \frac{\text{Cov}(\log(\zeta_r^D), \mathbf{UI})}{\text{Var}(\mathbf{UI})},$$

where $\text{Cov}(\cdot)$ is the covariance, and $\text{Var}(\cdot)$ the variance. As discussed in section 2.3.4, it is plausible that UI take-up reduces the net value of applying for DI, i.e., that γ is negative. If the unobserved heterogeneity terms are correlated across equations (2.11) and (2.12), then the estimate $\hat{\gamma}$ is biased, because whether a person takes up UI (i.e., whether $\mathbf{UI} = 1$) depends on the net value $V_1^U - V_1^O$, which in turn depends on ζ_r^U. For instance, suppose that costs for UI take-up and DI application are positively correlated. This could be the case depending on whether people are timid about receiving transfer programs. A person with low costs of DI application (i.e., a high value of ζ^D) is then also more likely to have low costs of UI take-up (i.e. a high value of ζ^U). It follows that $\text{Cov}(\zeta_r^D, \mathbf{UI}) > 0$.

Consequently, unobserved location parameters for DI application and UI take-up that are positively correlated would result in a bias of $\hat{\gamma}$ towards a positive value. Conversely, if the correlation between the location parameters is negative, the estimate of UI take-up would be biased towards a more negative value.

In order to address the endogeneity of UI take-up, the equations for DI application and UI take-up will be jointly estimated. Since none of the net values are observed, the latent index model first needs to be translated into a model that can be estimated. To begin, note that the probability of observing a person taking up UI can be rewritten as

$$
\begin{aligned}
P(UI = 1|t = 1,\mathbf{x_t^U}, \mathbf{MB}, \zeta_r^u) = P(V_1^u - V_1^o > 0) = \\
P(\mathbf{x_1^{U\prime}}\beta^U + \mathbf{MB}\,\delta_3 + \log(\zeta_r^U) - \varepsilon^U > 0) \\
P(\mathbf{x_1^{U\prime}}\beta^U + \mathbf{MB}\,\delta_3 + \log(\zeta_r^U) > \varepsilon^U) \\
F(\mathbf{x_1^{U\prime}}\beta^U + \mathbf{MB}\,\delta_3 + \log(\zeta_r^U))\,,
\end{aligned}
$$

where $F(\cdot)$ is the cdf for the error term. Assuming that $F(\cdot)$ is of the type I extreme value distribution implies

$$
\begin{aligned}
P(UI = 1|t = 1,\mathbf{x_t^U}, \mathbf{MB}, \zeta_r^u) = \\
1 - \exp\left[-\zeta_r^U \exp(\mathbf{x_t^{U\prime}}\beta^U + \mathbf{MB}\,\delta_3)\right],
\end{aligned}
\tag{2.13}
$$

The same reasoning, applied to the net value of DI application, results in the following equation for the probability that the person applies at duration $t = T$, provided that the person did not apply before:

$$
\begin{aligned}
P(T = t\,|\,T > t-1,\ \ \mathbf{x_t^D}, \mathbf{UI}, \mathbf{MB}, \zeta_r^d) = \\
1 - \exp\left[-\lambda_t^0 \exp\left(\mathbf{x_t^{D\prime}}\beta^D + \mathbf{UI}\,\gamma + \mathbf{MB}\delta_1 + (\mathbf{MB}\cdot\mathbf{UI})\,\delta_2\right)\,\zeta_r^D\right].
\end{aligned}
\tag{2.14}
$$

Note that this specification of the probability of observing a worker apply for DI at duration $t = T$ is equivalent to a discrete-time proportional hazard rate to disability insurance application with flexible baseline hazard λ_t^0.

The likelihood function is constructed using equations (2.13) and (2.14). Each type r is represented in the population by a population fraction p_r, where $\sum_{r=1}^{R} p_r = 1$. The expected likelihood for an individual i is obtained by summing over the likelihood of each type, weighted by the probability p_r that the person belongs to type r:[19]

$$
\begin{aligned}
L_i = \sum_{r=1}^{R} p_r \times & \left(\exp\left[-\zeta_r^U \exp(\mathbf{x_{ti}^{U}}'\beta^U + \mathbf{MB_i}\,\delta_3) \right] \right)^{1-UI_i} \\
& \times \left(1 - \exp\left[-\zeta_r^U \exp(\mathbf{x_{ti}^{U}}'\beta^U + \mathbf{MB_i}\,\delta_3) \right] \right)^{UI_i} \\
& \times \left(\exp\Big(-\left[\sum_{t=1}^{T_i - DI_i} \lambda_t^0 \exp\big(\mathbf{x_{ti}^{D}}'\beta^D + \mathbf{UI_i}\,\gamma + \mathbf{MB_i}\delta_1 + (\mathbf{MB_i}\cdot\mathbf{UI_i})\,\delta_2\big) \right] \zeta_r^D \Big) \right) \\
& \times \left\{ \left(1 - \exp\left[-\lambda^0(T_i) \exp\big(\mathbf{x_{T_i}^{D}}'\beta^D + \mathbf{UI_i}\,\gamma + \mathbf{MB_i}\delta_1 + (\mathbf{MB_i}\cdot\mathbf{UI_i})\,\delta_2\big)\, \zeta_r^D \right] \right) \right\}^{DI_i}.
\end{aligned}
\tag{2.15}
$$

where UI_i is a dummy for receiving unemployment benefits and DI_i is a dummy for applying for DI. Equation (2.15) is the likelihood for a system of equations with two equations and two endogenous variables, UI take-up and application for

[19] This likelihood pertains to a worker with a single spell of non-employment. For a worker with multiple spells indexed by s, the respective likelihood is

$$
\begin{aligned}
L_i = \sum_{r=1}^{R} p_r \prod_{s=1}^{S_i} & \times \left(\exp\left[-\zeta_r^U \exp(\mathbf{x_{sti}^{U}}'\beta^U + \mathbf{MB_{si}}\,\delta_3) \right] \right)^{1-UI_{si}} \times \left(1 - \exp\left[-\zeta_r^U \exp(\mathbf{x_{sti}^{U}}'\beta^U + \mathbf{MB_{si}}\,\delta_3) \right] \right)^{UI_{si}} \\
& \times \left(\exp\Big(-\left[\sum_{t=1}^{T_{si} - DI_{si}} \lambda_t^0 \exp\big(\mathbf{x_{sti}^{D}}'\beta^D + \mathbf{UI_{si}}\,\gamma + \mathbf{MB_{si}}\delta_1 + (\mathbf{MB_{si}}\cdot\mathbf{UI_{si}})\,\delta_2\big) \right] \zeta_r^D \Big) \right) \\
& \times \left\{ \left(1 - \exp\left[-\lambda^0(T_{si}) \exp\big(\mathbf{x_{T_{si}}^{D}}'\beta^D + \mathbf{UI_{si}}\,\gamma + \mathbf{MB_{si}}\delta_1 + (\mathbf{MB_{si}}\cdot\mathbf{UI_{si}})\,\delta_2\big)\, \zeta_r^D \right] \right) \right\}^{DI_{si}},
\end{aligned}
$$

DI.

Identification: The substantial variation in UI benefits across states is used to identify their causal effect on application for DI. Table 2.1 presents minimum and maximum weekly benefit amounts and replacement rates for selected states. For instance, the minimum weekly benefit amount ranges from $10 in Florida and Louisiana to $75 in Washington. Since prior earnings are included in the model, UI benefits for two jobless workers with the same prior earnings can only be different if they reside in different states or in the same state at different times. Therefore, identification requires that state-level variation in unemployment benefits is not systematically related to unobserved characteristics of workers or states which influence the application decision for DI.

If not through functional form, identification of the endogenous UI take-up decision requires instruments and corresponding exclusion restrictions. I use several instruments that are included in the UI take-up decision but excluded from the hazard equation for DI application. The exclusion restriction requires that these observed characteristics affect the application decision for DI only through UI take-up. These instruments are and indicator that for whether or not a state as a waiting week for UI benefits, whether claim interviews can be conducted per telephone, and state-level able and available provisions. Conversely, the Principal Insurance Amount (i.e. DI benefits) is included in the hazard equation, but excluded from the UI take-up decision. These exclusion restrictions are justified since they pertain to separate and independent programs. Therefore, any characteristics of the UI program have no direct effect on the DI application procedure or outcome, and characteristics of the DI program do not directly influence UI eligibility or benefit level.

Random effects are generally identified through variation in the outcome which

cannot be accounted for by variation in observed characteristics. Since the causal effect of UI take-up and application for DI are identified through the instruments, the unobserved heterogeneity parameters and their correlation are identified through variation in the outcome which cannot be attributed to either instruments or other regressors.

The waiting time and outcome of disability insurance applications are only observed for those who apply for disability insurance. In order to include them, they first would have to be imputed in separate regressions. Unfortunately, it is problematic to find adequate instruments to identify these variables. While state-level initial application success rates for DI applications are available, their variation does not necessarily reflect variation in application determination practices across states. Strand (2002) shows that initial application success rates are higher in states where economic conditions are better. Similarly, I found that the initial state-level application success rate is negatively correlated with the percentage of workers in a state who apply for DI, as well as state-level unemployment rates. These results suggests that state-level initial application success rates reflect state-level variation in economic conditions, rather than different practices by SSA offices. When economic conditions are good, only people with dire health conditions apply for DI. These people also tend to have a good chance to be accepted into the program. Conversely, when economic conditions are difficult, many people apply for DI, even though their health problems are not clear-cut. Due to this selection issue, I abstain from imputing the waiting time and application success probability.[20]

[20]Model estimates with imputed waiting time and application success probability do not differ substantially from the ones presented here. It is also plausible that people with a lower waiting time or a higher application success probability have unobserved characteristics which are not correlated with regressors but affect both the application probability or waiting time and application for DI. These correlated random effects would bias parameter estimates (Heckman, 1979). However, since the main model is estimated with the full sample, sample selection does not constitute a threat to identify the effect of monthly UI benefits on application for DI.

2.4.2 Data

The primary data source is the Survey of Income and Program Participation (SIPP) for the years 1990 to 2004. The SIPP is a nationally representative sample of individuals 15 years of age and older of the civilian non-institutionalized population. People are interviewed once every four months, called a wave, for two to four years. When interviewed, respondents are asked to provide information about the preceding four months, called reference months. Connecting reference months of different waves generates panels, from which spells of non-employment following a job loss are identified.[21] In addition to the core questionnaire, respondents are asked detailed questions about various topics, which are called modules. Several health modules provide information about work limitations, health status, functional limitations, Activities of Daily Living (ADLs), and hospital stays in the past year. Table 2.2 presents SIPP modules that include health indicators. The second wave topical module also includes information about the main type of work limitation for those who had indicated having a work limitation. Answers were matched to the list of disabling conditions, specified in the so-called "Blue Book" of the SSA.[22] Applicants with work limitations included in the list of disabling conditions are accepted into the DI program at the third step of initial determination (see section 2.2.1). A more extensive discussion of the SIPP survey and variables created for this analysis can be found in Appendix 2.8.

SIPP surveys are matched to administrative data files containing information

Sample selection based on unobserved characteristics does play a role when assessing the effect of a longer waiting time or higher success chance on the probability to apply for DI. Kreider (1999) provides a thorough discussion of this issue. However, these parameter estimates are of secondary interest for this study.

[21] Panel surveys often suffer from seam bias, i.e. disproportionally large changes of responses between waves and disproportionally small changes of responses within waves. Seam bias is not a concern in this context because of the use of administrative information. Therefore, neither the date of DI application nor UI benefits suffer from a seam bias.

[22] See `http://www.ssa.gov/disability/professionals/bluebook/AdultListings.htm`.

about disability insurance applications. Application dates are identified through so-called 831 files, which track initial applications including the reconsideration stage. For appeal decisions, Master Beneficiary Records (MBR) and Payment History Updates (PHUS) data are used to correct application end dates and the final application determination decision. Administrative data sources and matching procedures are described in Appendix 2.8. Access to these administrative data is restricted and subject to approval by the Social Security Administration, the Census Bureau, and a federal fellowship. Due to the confidential nature of administrative data, all of the analysis involving this data was conducted at completely secured work stations in SSA's research department in Washington, D.C.

Estimation of the model requires information on UI benefits for those who receive and those who do not receive benefits. Reported unemployment benefits are problematic because of reporting bias (Meyer et al., 2008), and insufficient because those who do not receive UI do not report their potential benefits. In order to circumvent these issues, I follow Gruber (1997) in computing UI benefits by using UI laws from the Employment and Training Administration's *Significant Provisions of State Unemployment Insurance Laws* (various years) from the Department of Labor.[23] I use Social Securities' Detailed Earnings Records (DER) for benefit calculations.[24] Besides unemployment insurance benefits, additional state-level variables for able and available provisions are added to the sample, based on the documentation provided by the US Department of Labor's "Comparison of State UI Laws".[25] Some states also require UI recipients to actively

[23]See `http://www.ows.doleta.gov/unemploy/statelaws.asp`.

[24]Average earnings for workers in the sample in the years before their jobless spell are stable and slightly increasing. This gives me confidence that the earning records used are close to the earnings used by State agencies to compute unemployment insurance benefits. The correlation between imputed and reported unemployment benefits is about 0.8 in the sample. Reported unemployment benefits tend to be somewhat lower than imputed, which is consistent with under-reporting of these benefits.

[25]For years 2001 and later, documents are available from the Department of Labor's website `http://www.ows.doleta.gov/unemploy/statelaws.asp`. Daniel Hays from the Department

seek employment, and others explicitly state that UI claimants remain eligible if they become ill or disabled, as long as they do not refuse suitable work.

Furthermore, potential DI benefits (i.e. the Principal Insurance Amount, or PIA) are computed for each person and year, where the Detailed Earnings Records (DER) provide past earnings. The computation of the PIA is explained in Appendix 2.6. Furthermore, state-level unemployment rates from the Bureau of Labor Statistics are included in the model, as well as state-level initial application success rates for DI applications using three sources: the Lewin group for the years 1989 to 1995, Burkhauser, Butler, Weathers, and Houtenville for 1996 to 2000, and SSA for the years 2001 and later.[26]

After these imputations, a sample of workers who lost their job and who are both eligible for DI and UI is selected. Table 2.3 presents the selection steps. First, people who did not disclose their SSN (they cannot be matched to administrative records), who apply only for SSI (they are unlikely to qualify for UI benefits because of low labor force attachment), and who were in the military are disregarded. After these preliminary steps, workers who had lost their job at least once during the SIPP survey are selected. Next, workers are selected who are eligible for DI because of their past work history (i.e., who have positive earnings 5 of the last 10 years) and who report a work limitation at least once during the survey period. Furthermore, workers who are not eligible for UI because of too low earnings are disregarded. Finally, people on short-term layoff, people who receive pensions or are turning 62 during a spell, and disrupted spells are disregarded.[27] People who quit their job remain in the sample, since they can both receive UI

of Labor made available earlier years of these documents.

[26]Richard Burkhauser provided the first two datasets, which were used in Burkhauser et al. (2002b). SSA's award rates can be found at `http://www.socialsecurity.gov/disability/data/ssa-sa-mowl.htm`.

[27]Disrupted spells are spells for which at least one wave is missing. They account for about 3 percent of all spells.

and apply for DI, as corroborated by table 2.4. These selection steps leave 5,398 people in the sample. The Appendix 2.8 provides a detailed explanation of these selection steps.

2.4.3 Results

Sample description: Table 2.5 presents summary statistics of the sample. Monetary values are in thousands of 1990 dollars, in this and all subsequent tables. The average age is 40 years, about five years older than in other unemployment studies. In more than 80 percent of all months included in the sample, workers indicate a work limitation. During the majority of months, no problems with Activities of Daily Living or Functional Limitations are reported, but in 40 percent of the months, two or more ADLs are indicated. These indicators show that the people in the sample generally have health problems, but the majority are not fully inhibited from all kinds of work. The majority of people (66%) find employment, whereas about 10 per cent of the spells end with an application for disability insurance.[28] The remaining spells (about one-quarter) are right-censored. The observed average spell duration is 7.3 months, which is relatively high.[29] However, jobless duration is significantly right-skewed, and the median spell duration is 5 months. Workers take up UI benefits in 25 percent of all non-employment spells.

Figure 2.3 presents the Kaplan-Meier hazard rate to disability insurance application for a 15 month duration. The hazard rate exhibits a slight downward trend,

[28]The percent of spells ending with an application for DI is smaller than the percent of people applying for DI due to multiple spells.

[29]Due to right-censoring, the actual spell duration is even longer. In addition, spells "ending" with disability insurance application can be considered as not not ending for the purpose of measuring spell durations until a final determination has been reached and the person has been approved for DI, or until a rejected applicant has found employment again. I have calculated spell duration using this alternative definition of spell endings as well. The average spell duration is in this case with 7.57 months slightly higher (the median duration remains 5 months).

starting at more than 1.5 percent and decreasing to 1 percent after 15 months. It appears that the hazard rate increases somewhat during the sixth and seventh months, followed by a drop afterward.

An important result from the theoretical discussion (section 2.3.3) is that UI benefits may only affect DI application decision is there is sufficient overlap between the timing of benefit payment. With respect to UI claims, figure 2.4 displays the distribution of UI recipients over the duration of non-employment spells. Not surprisingly, workers are the most likely to receive UI benefits from the first to the seventh month of non-employment. However, the figure also shows that the distribution is substantially right-skewed. Even after more than a year without work, about 10 percent of all workers claim UI benefits.[30] With respect to DI benefits, table 2.5 shows that while the average waiting time for DI applications is 6.7 months, half of them are processed in a bit more than 3 months, and three-quarters in less than 6 months. The waiting times are roughly comparable to those found by Lahiri et al. (2008) and Benitez-Silva et al. (1999).[31] Table 2.6 presents the cumulative distribution of the first DI payment among those who have successfully filed an application by the number of months into spells of non-employment. As can be seen, 16 percent of all DI beneficiaries in the sample receive their first payment within 5 months of being without employment. Apparently, the 5-month minimum waiting time is not binding for these workers.

Table 2.7 presents numbers, cells and row percentages for UI take-up and the

[30]Three reasons can explain this result. First, not all workers who claim UI benefits do so in the first month (about 80 percent of UI claimants claim benefits in the first two months). Second, extended benefits increase the number of months for which workers are eligible for UI benefits. Third, workers with UI benefits are less likely to become re-employed, and therefore remain longer in the sample.

[31]Lahiri et al. (2008) find an average waiting time of only 3 months using SIPP surveys 1990-1996. Benitez-Silva et al. (1999), using the Health and Retirement Survey, report a waiting time of 4.8 months *until benefits are first paid* for successful applications at initial determination, but an average waiting time of 15 months for successful applications at reconsideration and appeal. Averaging over both groups implies a mean waiting time of 8.5 months.

application for DI. As can be seen, in only 1.55 percent of all transitions are UI take-up and application for DI observed together. While the overlap is small, the number of cases (126) is large enough to estimate the effect of UI take-up on the application decision for DI. The small overlap is also not evidence that UI benefits have no effect on DI applications. To the contrary, if people consider UI and DI benefits as a substitute for one another, then one would expect to see few people receiving both.

Model estimates: Tables 2.8 and table 2.9 summarize the model results. All model estimations include demographic characteristics as listed, including dummy variables for calendar years, with 1990 as the reference year, and industry dummies. Due to the state-level instruments for UI take-up, the model does not use state fixed-effects but rather dummy variables representing Census divisions, with division I as the reference group.[32] Block bootstrapped standard errors with states as blocks are used for all regression models.

Table 2.8 presents estimates of the model as shown in equation (2.15). Model (1) pertains to estimates for which no unobserved heterogeneity between UI take-up and application for DI is assumed. As expected, having a work limitation and a higher principal insurance amount (PIA, i.e., DI benefits) increases the hazard to DI application. Having higher past monthly earnings and higher earnings of a spouse decreases the hazard to DI application. The estimate for the unemployment rate is positive, but very imprecisely estimated. The large standard errors suggest that there is substantial heterogeneity in how different rates of unemployment

[32]The Census divisions are as follows: Division 1: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont; Division 2: New Jersey, New York, Pennsylvania; Division 3: Indiana, Illinois, Michigan, Ohio, Wisconsin; Division 4: Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota; Division 5: Delaware, D.C., Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia; Division 6: Alabama, Kentucky, Mississippi, Tennessee; Division 7: Arkansas, Louisiana, Oklahoma, Texas; Division 8: Arizona, Colorado, Idaho, New Mexico, Montana, Utah, Nevada, Wyoming; Division 9: Alaska, California, Hawaii, Oregon, Washington.

affect search success.

Estimates for UI take-up generally have the expected direction. Work limitation, past monthly earnings before job loss, spousal earnings, and a waiting week all decrease the probability of taking up UI. A higher unemployment rate and higher potential monthly UI benefits both increase the probability that the worker claims UI. Able and available provisions do not seem to matter, except for states which have an actively seeking work provision, which deters UI claims somewhat. Finally, those who apply for DI are significantly less likely to take up UI benefits.

Turning to the primary coefficients of interest, of those who have take up UI, a higher monthly benefit amount (MB) reduces the hazard to DI application. The effect appears to be large, and is significantly different from zero at the 1 percent level. This result suggests that the insurance channel dominates the search effort channel, and that the waiting time is not a prohibitively strong barrier. The estimate for monthly UI benefits of those not receiving UI benefits is insignificant, which provides a supportive counterfactual result. For if other state-level factors correlated with the UI benefit level and DI application success were not controlled for, then the main effect of UI benefits would not be zero.

Concerning UI take-up, the estimate of the dummy variable of UI receipt on application for DI in the first model is slightly negative and not significant. This result would indicate that people do not worry that taking up UI forfeits their eligibility for DI, or that non-monetary eligibility requirements for UI claimants do not reduce the value of applying for DI. However, the estimate for UI take-up might not only measure the causal effect of UI take-up itself, but also correlated costs or eligibility between UI take-up and application for DI. To address this concern, we now turn to the second model.

The second model, in table 2.8, allows for a correlated response between the DI application and the UI take-up in the form of semi-parametric random effects. The number of types is selected using the BIC criterion.[33] Models with three types, reported in this table, had the lowest BIC value for this model. The share of people in the three different groups is estimated to be relatively equal, and the correlation between the unobserved types is 0.99. This implausibly high correlation is an artifact of two of the three location parameters being relatively close together. The correlation drops to about 0.55 for models with four or more types.[34]

Comparison of model (1) and model (2) reveals that most parameter estimates change little. However, the coefficient for UI take-up becomes significantly negative. Likewise, the coefficient for DI application in the UI take-up decision is now much more negative as compared to the first model. This result suggests that one group of people is more likely to apply for DI and to take-up UI, while the other group is less likely to do both. As reasoned in the theoretical section, such a positive relationship could be explained by the correlated costs of taking up UI benefits and applying for DI, or by correlated eligibility. For each group, UI take-up is associated with a lower hazard to DI application, but this relationship is obscured by correlated preferences or eligibility.

The estimate of UI take-up γ can be understood as a local average treatment effect (LATE) of those applicants for DI who are induced to apply due to variation in the instruments (e.g. Angrist, 2001). Since the instruments are state-level variation in UI eligibility and accessibility, the effect pertains to workers who receive UI benefits versus those who do not because of these characteristics. Unfortunately,

[33]The formula for the BIC is $-2\ln(L) + k\ln(N)$, where L is the maximized value of the likelihood function of the estimated model, k is the number of free parameters, and N is the number of observations.

[34]For two or more types, parameter results change only slightly when the model is estimated with different numbers of types.

instruments are not significant. For a first-stage linear-probability regression of UI take-up on the regressors used in the UI take-up equation, using the first month only, the F-statistic of the hypothesis that all instruments are zero is only 3.5. Therefore, instruments are weak and the local average treatment effect is likely to be biased.

In order to investigate whether UI benefits have different effects at different durations of the unemployment spell, the model is also estimated with duration-specific estimates of UI benefits for the hazard to DI applications. From the theoretical discussion, one would expect that parameter estimates of UI monthly benefits for earlier months, where the duration of UI benefits is longer, would be larger in magnitude. Table 2.9 reports the results from a model with duration-specific effects of monthly benefits. There is no clear change in the parameter values over duration.

Robustness Checks: In order to validate the result that higher UI benefits reduce the hazard to DI application, several robustness checks are considered. First, auxiliary regressors from model (1) and (2) in table 2.8 (spousal earnings, extended benefit periods and maximum UI benefit duration) are consistent with the hypothesis that higher UI benefits reduce the hazard to DI application. Higher spousal earnings function as income support similar to UI benefits, and reduce the hazard to DI application. For the maximum benefit duration and extended benefits, note that the net value of applying for DI, and therefore the hazard to DI application, decreases in B if the insurance effect dominates.[35]

[35]In addition, one would expect the effect of MB on the hazard to DI application to be larger in magnitude during extended benefit periods or for states with a longer maximum benefit duration. Unfortunately, further interactions with extended benefit periods do not support this hypothesis: MB interacted with extended benefit periods is not significant. It should be noted though that the effect of higher MB on UI take-up is insignificant as well. Therefore, it is questionable whether the current research format and sample size is able to properly identify different effects for periods with and without extended benefits separately.

Second, identification of the causal effect of UI monthly benefits on the hazard to DI application assumes that state UI monthly benefit levels and their changes are not correlated with other factors affecting applications for DI. One might suspect that states with favorable economic conditions have high UI replacement rates and fewer applications for DI. However, estimates for UI benefits are robust to inclusion of state-level initial application success rates for DI (see table 2.10). The state-level initial application success rate itself is negatively associated with the hazard to DI application, consistent with the notion that it proxies economic conditions.

Third, the model does not include state fixed-effects since they would prevent using time-invariant state-level variation in UI programs as instruments for the UI take-up decision. Focusing on those workers who received UI benefits allows for estimation of a hazard model with state fixed-effects. Table 2.11 presents the results for three different specifications. In the first column, the model is estimated without state fixed-effects and with clustered standard errors at the sample unit level.[36] Again, the effect of higher UI benefits is negative and significant. Introducing state fixed-effects in the second column does not change the size of the estimate. Therefore, state-level variation in UI benefits is not correlated with other state characteristics related to DI applications. However, the standard error increases slightly because of the 50 more parameters in the model. Finally, using clustered standard errors on the state level as shown in the third column increases the standard error for the UI monthly benefit amount further. These different specifications show that variation in UI benefits across states and over time correctly identify the effect of UI benefits on application for DI. However, the correlated nature of imputed UI benefits within states reduces the power of

[36]For this specification, clustered standard errors are used since resampling using states as blocks is unsuccessful.

rejecting the null hypothesis.

Table 2.12 uses different model specification for the same individuals. For these cross-sectional models, only the first month of non-employment spells is used. The columns show results from linear probability and logit models with and without state fixed-effects. As before, the effect of monthly UI benefits does not change much when state-level fixed effects are introduced, but the standard error for monthly UI benefit amount increases.

As a fourth robustness check, a SUR variation of the model is estimated. The model is estimated without the state-level instruments and the interaction between UI take-up and the UI monthly benefit amount. Error terms of the two equations are still allowed to be correlated. Table 2.13 presents results of this model. As expected, the coefficient for UI monthly benefits is still negative, but reduced in magnitude. It is the average effect of UI monthly benefits on the hazard to DI application of those who take up and who do not take up UI benefits. The coefficient is imprecisely estimated, however.

The final specification (table 2.14) shows the same model as in table 2.8, but with a slightly different specification of the the maximum UI benefit duration. State UI law for maximum UI benefit duration in combination with past earnings is used to calculate the maximum UI benefit duration for each individual. The coefficient for this variable is negative and significant. This indicates that also higher UI benefit duration might reduce the probability that unemployed, health impaired workers will apply for DI.

Quantitative implications: The coefficients in a proportional Cox Hazard model represent changes in the log of the hazard rate if the dependent variable changes by one unit. For instance, a one-unit increase in the Principal Insurance Amount

in table 2.8 implies a .913 increase in the log of the hazard rate. This is equivalent to an $exp(.913) = 2.5$ ratio of the new hazard rate compared to the old hazard rate, or a 150% increase. Since all monetary variables are in dollar variables, a one-unit increase in the PIA represents an increase of $1,000. The coefficient for the interaction term of the UI monthly benefit amount with UI take-up has about the same absolute size in the opposite direction.

In order to convert these marginal effects into elasticities, the average elasticity for the PIA and UI monthly benefits is calculated. To do so, I first compute hazard rates to DI application for each person and each month, using parameter estimates from the first model. If unobserved heterogeneity is considered, probabilities to take up UI benefits are also estimated. In this case, hazard rates and UI take-up probabilities are re-estimated until convergence is achieved.

From table 2.15, the elasticity for the Principal Insurance Amount is 0.672, while the elasticity of the UI monthly benefit amount is 0.094. The difference in the elasticities despite similar coefficients stems from the fact that only a quarter of the people in the sample receive UI benefits. Indeed, under the assumption that all people received UI benefits, the elasticity of MB is similar to the elasticity of PIA. [37]

Do these estimates imply that increasing UI benefits is cost-effective? Some simple calculations show that this is unlikely to be the case. For that, I first calculate the probability that a worker in the sample files an application over the course of a 9-month spell for current UI benefits, and then again for 10 percent

[37] To understand how the computed elasticities are related to the parameter estimates, recall that the average PIA is 0.672 in thousand 1990 U.S. dollar in table 2.5. For a worker with an average PIA, a one percent increase in the PIA is equal to $6.72 dollar, or $0.00672 thousand dollar increase. Multiplying 0.00672 by the percentage change of a one-unit increase in the PIA, 150%, implies an increase in the hazard rate of about 1%. For the average worker, therefore, the elasticity is about 1. Workers with a lower PIA have a lower elasticity, while workers with a higher PIA have a higher elasticity than 1. Since the distribution of the Principal Insurance Amount is right-skewed, the average elasticity is smaller than the elasticity for the average PIA.

higher UI benefits. In the sample, 13.38 percent apply for DI. This corresponds to an average hazard rate of 1.58%. The above elasticity estimates of 0.15 to 0.2 suggest that for a 10% increase in UI benefits, the hazard rate to DI application will drop by at most 2 percent, or to 1.55 percent. The smaller hazard rate implies that no less than 13.1 percent of the sample would apply for DI, which is a 0.3 percentage point decrease.[38]

Actuarial Tables from the Social Security Administration show that between 2000 and 2008, about 2 million people applied for DI.[39] Assuming that *all* of them would face transitions from working to not working as in the sample for this study, a 0.3 percent decrease in applications amounts to 6,000 fewer applications per year. On average, no more than half of applications during this time were successful. Therefore, the 10 percent increase in UI benefits would reduce the number of beneficiaries by 3,000 per year.

In von Wachter et al. (2010) (web appendix), estimates are presented for the present-discounted value of DI for an average new male and female beneficiary in 1997. These estimates are based on average duration in the DI program, as well as cash and Medicare benefits. They also include the indirect costs of the DI program in the form of lost earnings. If between half and two-third of the new beneficiaries are men, the average PDV of a new beneficiary is between $173,406 and $175,127 in 1997 dollars, or between $191,000 and $193,000 in 2001 dollars. Therefore, 3,000 less beneficiaries would amount to $575 to $580 million of saved benefits paid and more wages earned.

While substantial, these reduced costs are only a fraction of the costs due to higher UI benefits. Between 2000 and 2008, an average of more than 2.5 million

[38]Note that the probability of not applying during a spell of 9 months is $(1-\lambda)^9$, where λ is the hazard rate to DI application. Therefore, $1-(1-\lambda)^9$ is the probability that a worker will apply during a 9-month interval.

[39]See `http://www.ssa.gov/OACT/STATS/dibStat.html`.

workers were insured unemployed, i.e. received unemployment insurance.[40] Given an average benefit amount of $200 per week in 2001 dollars, a 10 percent increase in UI benefits amounts to $20 higher expenses per claimant per week, or $2.5 billion higher yearly expenses for 2 million claimants. This is more than 4.5 times as high as the savings due to fewer applicants. Moreover, these estimates are likely to be conservative, since not all of the 2 million yearly applicants for DI might face a situation similar to the workers selected for this study, and the indirect costs of longer UI duration because of higher UI benefits are not considered.

The quantitative implications for extending UI benefits are different. An increase of the maximum UI benefit duration by one month is equal to a 16.67 percent increase and translates into the same percentage reduction in the DI hazard rate, since the elasticity is -0.927. This implies a decrease in the number of applicants from 13.38 to 11.1 percent, or a 2.28 percent decrease. Using the same numbers as above results in a decrease in the number of applicants by 45,000, or a reduction on overall costs of $4.3 billion. In this case, therefore, the savings due to fewer DI applications are substantial.

2.5 Conclusion

This paper investigates how unemployment insurance benefits affect the decision to apply for disability insurance. Theoretical considerations suggest that an increase in unemployment benefits reduces the value of applying for DI through an insurance channel, but increases the value of applying for DI through a search effort channel. Furthermore, institutional barriers, such as a long waiting period or short UI benefit duration, reduce the magnitude of both channels. Besides UI

[40]The number of insured unemployed workers are provided by the Federal Reserve Bank for St.Louis.

benefits, the decision to receive UI may reduce the value of applying for DI, if people worry that it reduces their chances for a successful application.

My empirical results indicate that higher UI benefits do indeed reduce the hazard to DI application. The quantitative effect is also sizable for those who receive UI benefits. These results imply that short-term income transfers such as unemployment insurance have an influence on the decision to apply for DI. Furthermore, introducing unobserved heterogeneity into the model suggests that the UI take-up itself reduces the hazard to DI application.

Although this paper has focused on the role of unemployment insurance take-up and benefits on DI applications, its results may be used more broadly to understand the role of income flows and cash transfers on the decisions of marginal applicants. For instance, this paper has emphasized that application decisions for DI appear to be much more sensitive to even short-term cash incentives than has been previously acknowledged, at least among health impaired workers who have lost their jobs and who rely on short-term cash assistance such as UI benefits. Providing cash and other assistance for such workers could be a promising policy approach. Back-of-the-envelope calculations suggest that increasing UI benefits might not be cost-effective, but increasing the maximum UI benefit duration might be.

2.6 Appendix: Computation of the Principal Insurance Amount

Computation of the Primary Insurance Amount (PIA) follows Social Security's rules and regulations for benefit calculation (Code of Federal Regulations, Part 404, Subpart C) and proceeds in two steps. First, Average Indexed Monthly Earnings (AIME) are obtained. Second, these are used to calculate the PIA. For the first step, taxable earnings subject to Social Security benefits from the Detailed Earnings Records (DER) for each year are used. All earnings in excess of the taxable maximum in a particular year are truncated at the maximum. These earnings are then re-expressed as average monthly earnings. The AIME of a person at year t with an earnings history starting at $t_0 < t$ is given by:

$$AIME_t = \frac{1}{(t - t_0)} \sum_{\tau=t_0}^{t} Y_\tau \cdot \max\left[\frac{\overline{Y}_{t-2}}{\overline{Y}_\tau}, 1\right],$$

where Y_τ are the person's average monthly earnings in year τ, which are inflated to current dollars by the average wage in the United States economy two year's prior to the year of interest, $(\overline{Y}_{t-2})$, divided by the average wage rate in year τ. In addition, on-fifth of the years with the lowest earnings, to a maximum of five years, are disregarded.

For the second step, the Primary Insurance Amount is computed using the piecewise linear formula,

$$PIA = \begin{cases} 0.9 \cdot AIME & \text{if } AIME \; \epsilon \; [0 \; , b_1] \\ 0.9 \cdot AIME + 0.32 \cdot (AIME - b_1) & \text{if } AIME \; \epsilon \; [b_1, b_2] \\ 0.9 \cdot AIME + 0.32 \cdot (AIME - b_1) + 0.15 \cdot (AIME - b_2) & \text{if } AIME > b_2 \end{cases}$$

where the "bend points" b_1 and b_2 are rescaled every year by the average wage growth of the economy. Average wages and bend points can be found in the Annual Statistical Supplement of the Social Security Administration.

2.7 Appendix: Proofs and Generalization of the model

2.7.1 Generalization of proposition 1 for multiple-period change of UI benefits

Consider a \$1 increase in UI benefits for all months $t = 1, ..., B$. For simplicity, the value of applying at period $t = 1$ is compared to the value of not applying throughout the months benefits are paid. Then, the derivative of the value of not applying with respect to UI benefits in period k, where $1 \leq k \leq B$ is

$$\frac{dV_1^s}{db_k} = \beta^k \prod_{j=1}^{k} (1 - p_j^s) u'(b_k) \, .$$

Since $b_k = b_l = b$, for all $k, l \epsilon [1, B]$, the derivative of the value of not applying with respect to UI benefits for all months $t = 1, ..., B$ can be stated as follows:

$$\frac{dV_1^s}{db} = \left(\sum_{k=1}^{B} \beta^k \prod_{j=1}^{k}(1-p_j^s)\right) u'(b) = P_1^s u'(b)\,. \tag{2.16}$$

For the value of applying for DI at time $t = 1$, three possibilities need to be distinguished for each period $k\epsilon[1, B]$: (i) no determination has been made; (ii) the application was denied; and (iii) the application was approved. A denial or approval can occur during all months prior to k. Adding up probabilities results in

$$\frac{dV_1^a}{db_k} = P_{1,k}^a u'b(k) + P_{2,k}^a \alpha u'(d+b_k) + P_{3,k}^a (1-\alpha) u'(d+b_k)\,,$$

where

$$\begin{aligned}
P_{1,k}^a &= \beta^k (1-q)^k \prod_{j=1}^{k}(1-p_j^a) \\
P_{2,k}^a &= \beta^k q \sum_{j=1}^{k}(1-q)^{j-1} \prod_{i=1}^{j}(1-p_i^a) \\
P_{3,k}^a &= \beta^k q \sum_{j=1}^{k}(1-q)^{j-1} \prod_{i=1}^{j}(1-p_i^a) \prod_{i=j+1;k\geq 2}^{k}(1-p_i^r)\,.
\end{aligned}$$

The probability $P_{1,k}^a$ pertains to the case that no decision is reached until period k, and the worker is still without employment. The other two probabilities are for the case that a decision has been reached, either in favor ($P_{2,k}^a$) or against

$(P^a_{3,k})$ the applicant. Summing up the derivatives of the value of applying at $t = 1$ for $k = 1, ..., B$ yields the following expression:

$$\frac{dV^a_1}{db} = P^a_1 u'(b) + P^a_2 \alpha u'(d+b) + P^a_3 (1-\alpha) u'(b)\,, \tag{2.17}$$

where

$$P^a_1 = \sum_{k=1}^{B} P^a_{1,k} \quad ; \qquad P^a_2 = \sum_{k=1}^{B} P^a_{2,k} \quad ; \qquad P^a_3 = \sum_{k=1}^{B} P^a_{3,k}\,.$$

Combining equation (2.16) and equation (2.17), and rearranging terms, it then follows that a \$1 increase in UI benefits for all months $t = 1, ..., B$ decrease $V^a_1 - V^s_1$ iff

$$\alpha \left(\frac{P^a_3 u'(b) - P^a_2 u'(d+b)}{u'(b)} \right) > P^a_1 + P^a_3 - P^s_1\,.$$

2.7.2 No Effect of UI benefits if the waiting time becomes large

The first step is to show that P^a_2 and P^a_3 approach zero when the waiting time goes to infinity. For that, note that for any finite k, $\lim_{q\to 0}(1-q)^k \to 1$. Consider first the case that $k = 2$. If follows directly that $P^a_{s,2} \to 0$ as $q \to 0$, since $\lim_{q\to 0} q(1-q) = 0$ and the probabilities of finding re-employment are bounded

by 1. Furthermore, since $(1-q) \geq (1-q)^k$ for any finite $k \geq 1$ and $q \leq 1$, it follows that $P^a_{2,k} \to 0$ as $q \to 0$ for any finite k. Therefore, $P^a_2 \to 0$ as $q \to 0$, and, by the same reasoning, $P^a_3 \to 0$ as $q \to 0$.

Since $\lim_{q\to 0}(1-q)^k \to 1$, $\lim_{q\to 0} P^a_1 \to \sum_{k=1}^{B} \beta^k \prod_{j=1}^{k}(1-p^a_j)$. Therefore, if $p^a_t = p^s_t$ for all t for $\lim_{q\to 0}$, then $P^s_1 = P^a_1$. To show this, consider the value of waiting for the outcome of the DI application when $q \to 0$ is

$$\lim_{q\to 0} \tilde{V}^a_t = \max_{s_{t+1}} \left\{ u(b) - s_{t+1} + \beta p(s_{t+1}) V^e_{t+1} + \beta(1-p(s_{t+1}))\tilde{V}^a_{t+1} \right\}.$$

This is the same maximum problem as for the value of not applying at time t, V^s_t. Therefore, $\lim_{q\to 0} \tilde{V}^a_t = V^s_t$ for all t, and it follows that $\lim_{q\to 0} P^s_1 = P^a_1$. Finally, since $\lim_{q\to 0} \frac{dV^a_1}{db} = P^a_1 u'(b) \Rightarrow \lim_{q\to 0} \frac{d(V^a_1 - V^s_1)}{db} = 0$ $\square$

2.8 Appendix: Data description and sample selection

Survey of Income and Program Participation The SIPP core survey includes the following variables: age, gender, race, marital status, whether the spouse works, earnings of spouse, education, employment status, UI take-up, Worker's Compensation take-up, number of people in the household, whether the household has children under 18 years, and work limitation (SIPP 1996 and later).

The dummy for being white is equal to one if the person indicates being white, and zero otherwise. Marital status is one if the person has a spouse at home or

currently not at home. A person is considered to have a high school degree if she or he completed 12 years of school. See Jaeger (1997) for recommendations on recoding education questions. The variable "Some college" is equal to one if the person has more than 12 years of education. A month of non-employment is a month during which the person has been without a job for at least one week, including temporary layoffs, but excludes weeks of being absent from work. UI and Worker's Compensation take-up are equal to one if the person received a respective income transfer during a spell. The work limitation variable is asked in every core questionnaire beginning with the 1996 SIPP, but in the first wave and for selected health modules beforehand (see table 2.2). In both cases, the variable is one if the person ever indicated a work limitation.

In health modules of the second wave, respondents who indicated a work limitation were asked to name the disability category of their primary limitation. The answer is matched to impairments listed in Social Securities' "Blue Book" in order to create a dummy variable "Limitation on list of impairments". General health has five scales, from which five dummy variables are created. Functional Limitations include difficulties to see, to hear, to speak, to lift 10 lbs., to walk stairs, and to walk a quarter of a mile. Activities of Daily Living include having any difficulty to take a bath or shower, to get dressed, to eat, and to use the toilet. For these two health measures, dummy variables for numbers up to four of affirmative answers are created. The dummy variable "Person had been to hospital" indicates whether the person was a patient in a hospital during the last year. For waves not covered by health modules, the most recent answer is imputed. For waves before the first health module, the answers of the first health module are imputed.

Administrative records Administrative records include the so-called 831 files, the Master Beneficiary Records (MBR), the Payment History Updates (PHUS), Supplemental Security Earnings (SSR) and Detailed Earnings Records (DER). The 831 files identify applicants and their date of filing a claim. They contain information about initial determination up to the reconsideration stage. This information is augmented for people who appeal an initial denial. Appeal decisions as well as benefit payment information are contained in the MBR and PHUS records for DI applicants, and in the SSR records for SSI applicants. They are used to correct the application determination date and, potentially, the application decision for such appeals. SSR records are used because some applicants for DI also apply for SSI. These applicants are kept in the sample, while those who apply exclusively for SSI are excluded from the sample. After matching 831 files to MBR, PHUS and SSR records, they are matched to SIPP surveys. Detailed Earnings Records (DER) contain yearly information about wage earnings and tips, as well as whether they are covered by Social Security. All records are matched using Social Security numbers (SSN).

UI benefits and UI law: UI benefits are imputed using state laws and earnings records from the Detailed Earnings Record. The maximum earnings during the year in which the spell began and the preceding year are used to compute UI benefits.

For the variables "Suitable Work" and "Usual Work", three different dummy variables are created: whether a state requires UI claimants to accept any work, suitable work, or usual work. Since the three categories are mutually exclusive, the dummy variable for any work is used as a reference category. If the variable "Actively Seeking" equals one, it means that a state requires UI claimants to provide evidence that they are seeking employment. The variable "Disability

Provision" equals one if a state declares that UI claimants who become ill or disabled after having filed their claim remain eligible as long as they do not refuse suitable work. The variable "Telephone Interview" equals one if claims can be filed via telephone, and the variable "Waiting Week" equals one if there is a waiting week during which eligible UI claimants do not receive benefits.

Monetary eligibility is determined using past earnings as for UI benefits imputation and UI state laws on past earnings requirements. If earnings exceed the threshold set by the state in a given year, the person is considered eligible based on the monetary criteria.

Sample selection: Table 2.3 presents all selection steps with corresponding sample sizes. The starting sample is the universe of 258,130 people from SIPP panels from 1990 to 2004 who were between 20 and 65 years old for at least one wave of a survey. As a first step, people who did not disclose their SSN are disregarded. Next, people who have been in the army are eliminated, as well as those who applied, are applying, or will apply for Social Security for the Disabled and Blind (SSI) alone. As a last step of the preliminary sample selection, people who report at least one month of employment, one month of non-employment, and one month for which they report a work limitation are selected. These preliminary selection steps result in a sample of 12,905 people; 1,922 of them apply for DI during the survey.

For these people, spells of non-employment are created, which can either end in re-employment, application for DI, or be right-censored. Afterward, spells where applicants work during the month they file an application are excluded. This selection step would reduce the number of people in the sample by the same amount as the number of applicants in the sample if only one spell per person was

observed. However, some applicants who work while submitting an application have prior spells of non-employment. These people remain in the sample, albeit not their application episode. Therefore, the number of observed applications decreases more than the number of people in the sample.

Next, spells for which no application begin is observed are disregarded. These are either beneficiaries or people who are already in the process of applying at the beginning of the spell. Since beneficiaries do not count as applicants, this step decreases the overall number of people in the sample by more than the number of applicants. The next step disregards spells with left-censored employment information. Since most spells with left-censored employment information also have left-censored application begin information, most of these spells are eliminated at the previous selection step.

Individuals are further required to have sufficient prior employment and earnings to pass the employment and earnings requirements for disability insurance and unemployment insurance, respectively. Specifically, individuals need to have positive earnings in the Detailed Earnings Records for at least 5 of the last 10 years to be eligible for DI. Moreover, their earnings in the last year before job loss needs to be sufficiently high such that they are eligible for UI benefits based in monetary eligibility stipulations.

The final selection step disregards spells during which people turn 62, are on short-term layoff, or receive a pension. Spells are considered as layoffs if the person reports being on layoff for at least one week. In this last selection step, disrupted spells are also eliminated. These are non-employment spells for which one or more waves are missing.

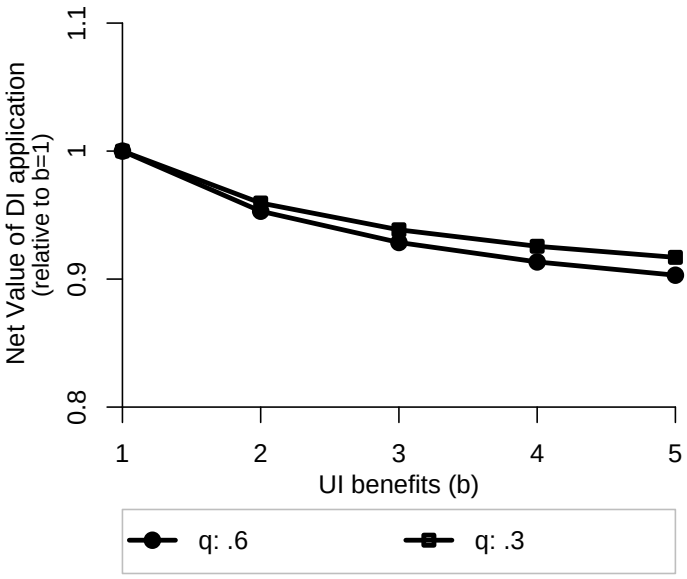

Figure 2.1: Interaction between waiting time and UI benefits.

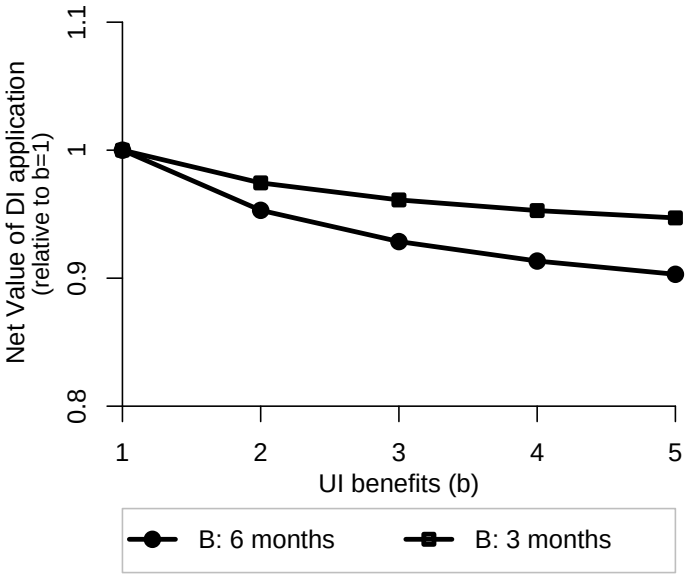

Figure 2.2: Interaction between UI duration and UI benefits.

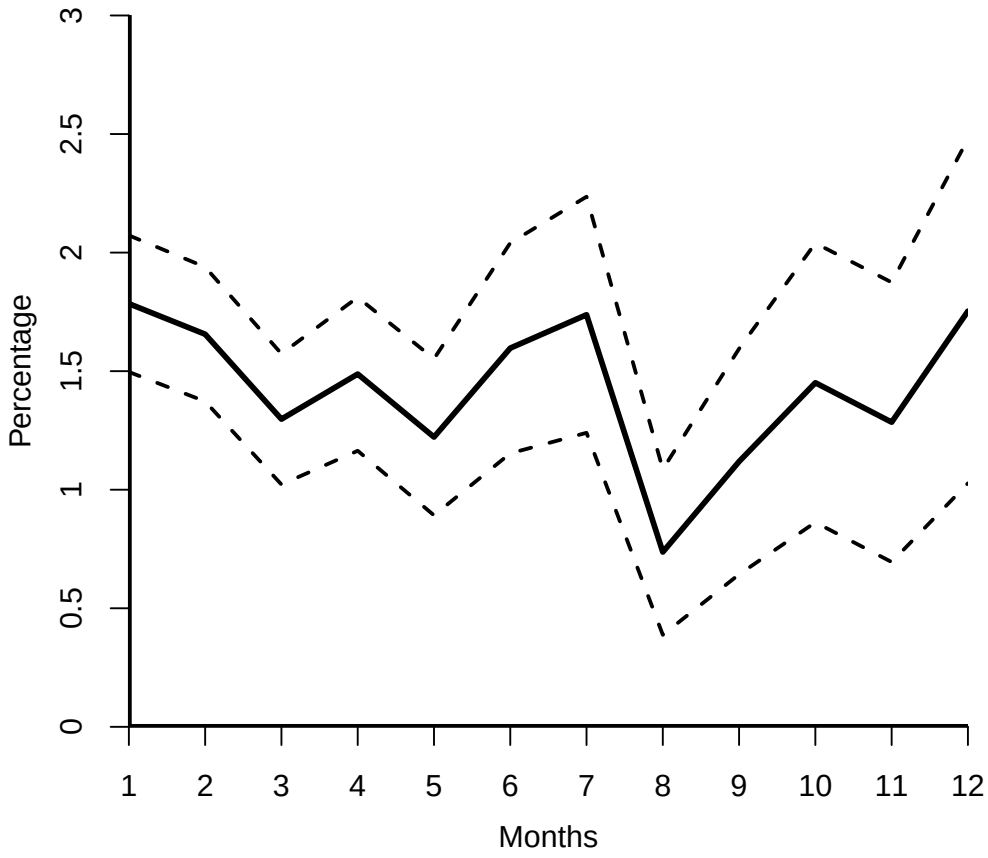

Figure 2.3: Hazard Rate of applying for disability insurance. Striped lines indicate 95 percent confidence intervals.
Source: SIPP panels 1990-2001 matched to SSA's administrative records on disability insurance applications and awards.

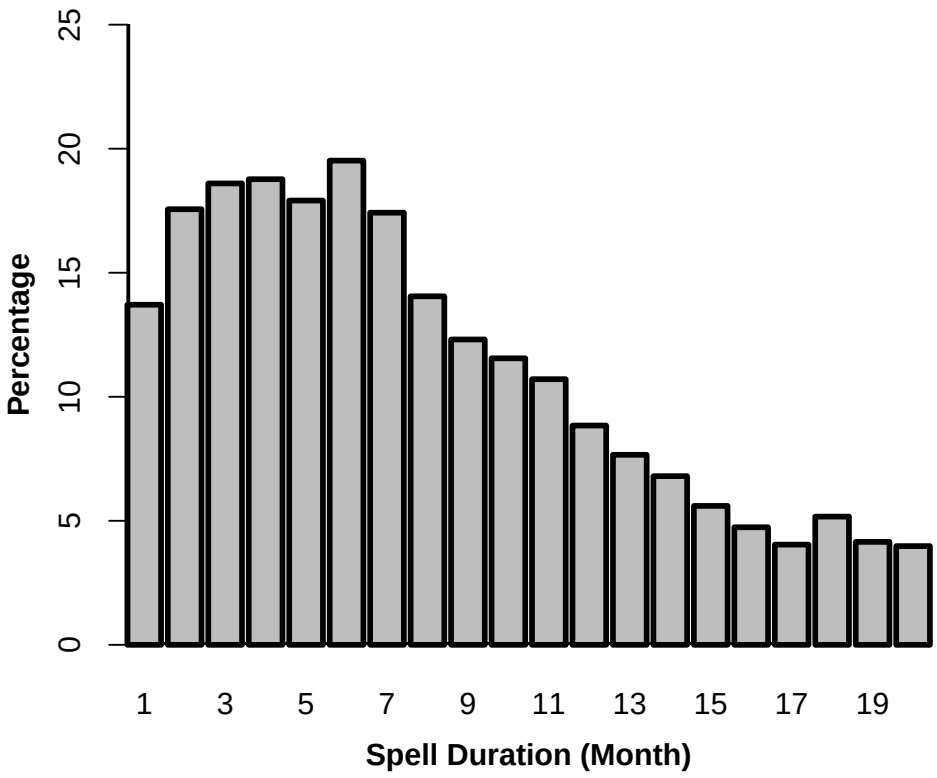

Figure 2.4: Fraction of unemployed workers who receive UI benefits by month of unemployment.
Source: SIPP panels 1990-2001 matched to SSA's administrative records on disability insurance applications and awards.

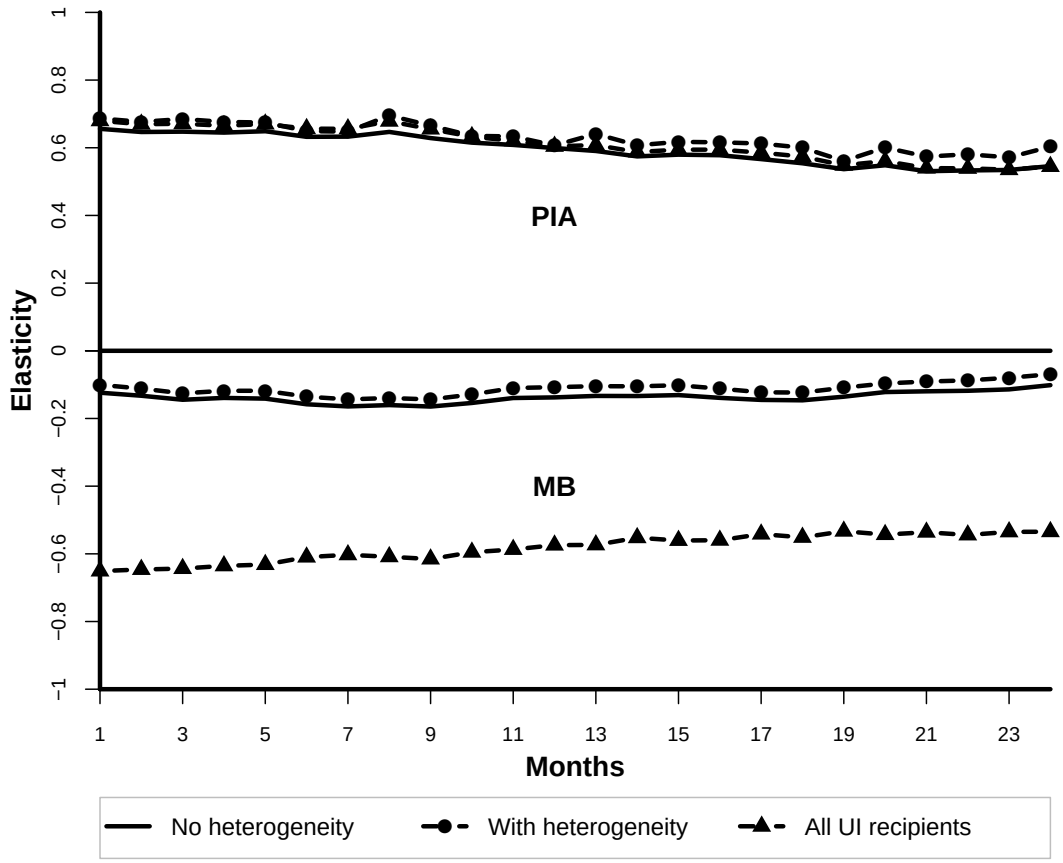

Figure 2.5: Comparison of Elasticities for a 1 percentage increase in the Principal Insurance Amount (PIA, positive elasticities) and UI Monthly Benefit Amounts (MB, negative elasticities) on the hazard rate to DI application.
Source: Parameter estimates from Models (1) and (2) from table 2.8.

Table 2.1: State Benefit Amount Formulas for January 1996 (selected states)

State	Min	Max	Replacement Rate (percent)
Alabama	22	180	54.17
Arkansas	47	264	50.00
D.C	50	359	50.00
Florida	10	250	50.00
Illinois	51	251	49.50
Kansas	65	260	55.25
Louisiana	10	181	52.00
Maine	14	347	59.09
Mississippi	30	180	50.00
New Jersey	60	362	60.00
New York	40	300	50.00
Oregon	70	301	70.00
South Carolina	20	213	50.00
Tennessee	30	200	50.00
Virginia	65	206	52.00
Washington	75	350	52.00
Wisconsin	52	274	52.00

NOTES. – Source: Significant Provisions of State Unemployment Law, January 1996. Dollar values are expressed in January 1996 values. Replacement rates are expressed as percentage of weekly wages.

Table 2.2: SIPP Modules and Health Indicators

Panel and Wave	Work Lim.	Dis. type	Health	Func. Lim.	ADL	Hospital
SIPP 1990, Wave 2	X	X				
SIPP 1990, Wave 3	X		X	X	X	X
SIPP 1990, Wave 4						
SIPP 1990, Wave 6			X	X	X	X
SIPP 1990, Wave 7	X					
SIPP 1991, Wave 2	X	X				
SIPP 1991, Wave 3	X		X	X	X	X
SIPP 1991, Wave 4	X					
SIPP 1991, Wave 7						
SIPP 1992, Wave 2	X	X				
SIPP 1992, Wave 4						
SIPP 1992, Wave 6			X	X	X	X
SIPP 1992, Wave 7	X					
SIPP 1992, Wave 9	X		X	X	X	X
SIPP 1993, Wave 2	X	X				
SIPP 1993, Wave 3	X		X	X	X	X
SIPP 1993, Wave 4	X					
SIPP 1993, Wave 6	X		X	X	X	X
SIPP 1993, Wave 7						
SIPP 1996, Wave 2		X				
SIPP 1996, Wave 3	X		X			X
SIPP 1996, Wave 5	X			X	X	
SIPP 1996, Wave 6	X		X			X
SIPP 1996, Wave 9	X		X			X
SIPP 1996, Wave 11	X			X	X	
SIPP 1996, Wave 12	X		X			X
SIPP 2001, Wave 2		X				
SIPP 2001, Wave 3	X		X			X
SIPP 2001, Wave 5	X			X	X	
SIPP 2001, Wave 6	X		X			X
SIPP 2001, Wave 8	X			X	X	

NOTES. – Source: SIPP topical modules 1990-2001. An X indicates that the module contains information about the respective topic. For instance, SIPP 1990, Topical Module 3 contains information about general health, functional limitation, ADL, and hospital stays. The work limitation question is asked in all core questionnaires of wave 1. For variable explanation and imputation, see appendix 2.8.

Table 2.3: Selection Steps and Sample Size

Selection steps	**Sample size**	**Applicants**		
		(Sample size)	(% of sample)	(% of initial appl.)
People 20-65	258130	5233	2.03	100.00
Disclose SSN	189533	5026	2.65	96.04
Civilians	187096	4992	2.67	95.39
No SSI	181244	3622	2.00	69.21
Work limitation	30345	3169	10.44	60.56
Non-employment spell	12905	1922	14.89	36.73
Not working while applying	12725	1553	12.20	29.68
Application start date observed	10591	1144	10.80	21.86
Non-employment spells not left-censored	10578	1136	10.74	21.71
Sufficient prior employment and earnings	7301	905	12.39	17.29
Not 62, no layoff, pension or disrupted spell	5398	697	12.91	13.31

NOTES. – Source: SIPP panels 1990-2001 matched to SSA's administrative records on disability insurance applications and awards. For a description of the selection steps, see appendix 2.8. The second to fourth column refers to SIPP respondents who apply for DI during the time the survey is conducted. The second column refers to the number of applicants, while the third and fourth columns show the percentage of applicants in the sample and the percentage of applicants relative to the initial number of applicants, respectively.

Table 2.4: Quit, UI take-up and application for DI

Quit		UI take-up: No	UI take-up: Yes
No	Cell percentage	55.38	21.68
	Row percentage	71.80	28.11
Yes	Cell percentage	18.43	4.38
	Row percentage	80.61	19.16

Quit		DI application: No	DI application: Yes
No	Cell percentage	69.18	7.88
	Row percentage	89.70	10.22
Yes	Cell percentage	21.50	1.32
	Row percentage	94.02	5.75

NOTES. – Source: SIPP panels 1990-2001 matched to SSA's administrative records on disability insurance applications and awards. See appendix 2.8 for details. All results are expressed as percentages of transitions.

Table 2.5: Summary Statistics

	Mean	Std.	First Quartile	Median	Third Quartile
Age	40.152	10.571	32.000	40.000	48.000
White	0.839	—	—	—	—
Sex	0.479	—	—	—	—
Household size	3.238	1.576	2.000	3.000	4.000
Children under 18	0.480	—	—	—	—
Married	0.557	—	—	—	—
Spouse works — Married	0.380	—	—	—	—
High School Degree	0.807	—	—	—	—
College	0.310	—	—	—	—
Spell Duration	7.277	6.642	3.000	5.000	9.000
Number of transitions	1.438	0.766	1.000	1.000	2.000
Previous transition	0.300	—	—	—	—
Outcome: Application	0.091	—	—	—	—
Outcome: Employment	0.670	—	—	—	—
Right Censored	0.237	—	—	—	—
Work Limitation	0.816	—	—	—	—
Will be work limited	0.092	—	—	—	—
Limitation on list of impairments	0.117	—	—	—	—
Health: excellent	0.130	—	—	—	—
Health: very good	0.218	—	—	—	—
Health: good	0.358	—	—	—	—
Health: fair	0.210	—	—	—	—
Health: poor	0.083	—	—	—	—
ADL: 0 problems	0.542	—	—	—	—
ADL: 1 problem	0.044	—	—	—	—
ADL: 2 problems	0.397	—	—	—	—
ADL: 3 problems	0.011	—	—	—	—
ADL: 4+ problems	0.005	—	—	—	—
FL: 0 problems	0.643	—	—	—	—
FL: 1 problem	0.170	—	—	—	—
FL: 2 problems	0.093	—	—	—	—
FL: 3 problems	0.072	—	—	—	—
FL: 4+ problems	0.022	—	—	—	—
Person had been to hospital	0.186	—	—	—	—
Person has health insurance	0.615	—	—	—	—
Monthly earnings before job loss	1.299	1.414	0.599	0.994	1.624

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TABLE 2.5 (CONTINUED FROM PREVIOUS PAGE)

	Mean	Std.	First Quartile	Median	Third Quartile
Monthly earnings of spouse	0.771	1.546	0.000	0.000	1.183
Monthly earnings of spouse — work	1.892	1.978	0.748	1.568	2.569
Principal Insurance Amount	0.676	0.310	0.435	0.616	0.900
UI take-up	0.263	—	—	—	—
Monthly UI Benefit Amount (MB)	0.596	0.266	0.375	0.598	0.800
MB — UI take-up	0.650	0.259	0.453	0.654	0.833
Person received Worker's Comp.	0.089	—	—	—	—
Spell with extended benefits	0.299	—	—	—	—
Unemployment rate	0.058	0.016	0.047	0.057	0.069
UI maximum benefit duration	5.974	—	—	—	—
Waiting week for UI benefits	0.859	—	—	—	—
Telephone interviews	0.211	—	—	—	—
Disability provision	0.103	—	—	—	—
Able and available: any work	0.652	—	—	—	—
Able and available: suitable work	0.169	—	—	—	—
Able and available: usual work	0.179	—	—	—	—
Able and available: seeking work	0.711	—	—	—	—
Waiting Time — Application	6.702	9.982	1.900	3.233	5.867
Successful application — appl.	0.527	—	—	—	—
DI initial application success rate					

NOTES. – Source: SIPP panels 1990-2001 matched to SSA's administrative records on disability insurance applications and awards. Construction of spells is explained in appendix 2.8. All dollar values are deflated to January 1990 values.
Variables which are reported once per person: age (as of first month of first non-employment spell), white, male, married (as of first month of first non-employment spell), high-school graduate (including some college), college degree, number of transitions, waiting time for DI, application success for DI, Worker's Compensation receipt.
Variables which are reported once per spell: UI take up, exit: applied, exit: employed, exit:censored, UI Monthly Benefit Amount (as of first month of spell), extended benefits during spell, waiting week, average highest monthly earnings last or this year, previous transition, limitation on list of impairments.
Variables which are reported once per year: Principal Insurance Amount.
Variables which are reported once per month: spouse works, monthly earnings of spouse (conditional on spouse working), unemployment rate, maximum benefit duration, waiting week for UI benefits, telephone interviews, disability provisions, able and available provisions, DI initial application success rate, spell duration.
Variables which are reported once per month, but observed once per topical module: health, work limitation (SIPP 1990-1993; defined as whether person ever indicated a work limitation), Activities of Daily Living, Functional Limitations, person had been to hospital, person has health insurance. Topical variables are imputed to reflect the last observed answer.
Variables which are reported once per wave: number of people in the household, household has children under 18, work limitation (SIPP 1996-2001; defined as whether person ever indicated a work limitation).

Table 2.6: Cumulative distribution of first DI benefit payment

Duration	Cumulative Percentage of first DI payment
1 to 3	5.81
4	11.40
5	15.59
6	20.24
7	32.33
8	43.96
9	50.01
10	54.20

NOTES. – Source: SIPP panels 1990-2001 matched to SSA's administrative records on disability insurance applications and awards. See appendix 2.8 for details. The table reports the first three months of non-employment together to avoid risk of disclosure.

Table 2.7: UI take-up and application for DI

		DI application	
UI take-up		No	Yes
No	Cell percentage	66.21	7.61
	Row percentage	89.55	10.29
Yes	Cell percentage	24.47	1.59
	Row percentage	93.89	6.11

NOTES. – Source: SIPP panels 1990-2001 matched to SSA's administrative records on disability insurance applications and awards. See appendix 2.8 for details. All percentages are expressed relative to number of transitions.

Table 2.8: Hazard Model Estimates: Constant effect of MB

		(1)		(2)	
Part	Regressors	Coeff.	SE	Coeff.	SE
DI application	Work Limitation	0.335	(0.135)	0.307	(0.153)
DI application	Past Monthly Earnings	−0.050	(0.115)	−0.051	(0.118)
DI application	Monthly Earnings (spouse)	−0.080	(0.040)	−0.097	(0.074)
DI application	Spell has Extended Benefits	−1.129	(0.117)	−1.107	(0.195)
DI application	Maximum UI benefit duration	−0.102	(0.043)	−0.111	(0.058)
DI application	Unemployment Rate	0.776	(2.868)	−0.677	(5.119)
DI application	Principal Insurance Amount	0.913	(0.261)	0.945	(0.395)
DI application	MB	−0.018	(0.254)	0.101	(0.409)
DI application	MB x UI take-up	−1.148	(0.515)	−1.347	(0.785)
DI application	UI take-up	0.019	(0.312)	−0.693	(0.612)
UI take-up	Work Limitation	−0.180	(0.058)	−0.183	(0.147)
UI take-up	Past Monthly Earnings	−0.058	(0.028)	−0.056	(0.030)
UI take-up	Monthly Earnings (spouse)	−0.095	(0.030)	−0.113	(0.070)
UI take-up	Spell has Extended Benefits	0.217	(0.055)	0.280	(0.122)
UI take-up	Maximum UI benefit duration	−0.098	(0.023)	−0.110	(0.064)
UI take-up	Unemployment Rate	5.523	(3.039)	6.488	(5.288)
UI take-up	MB	0.862	(0.157)	0.933	(0.253)
UI take-up	DI application	−1.206	(0.328)	−1.781	(0.507)
UI take-up	Waiting Week	−0.035	(0.134)	−0.050	(0.208)
UI take-up	Telephone Interview	0.052	(0.110)	0.044	(0.213)
UI take-up	Disability Provision	0.168	(0.113)	0.203	(0.280)
UI take-up	Suitable Work	0.079	(0.142)	0.092	(0.252)
UI take-up	Usual Work	0.068	(0.188)	0.032	(0.311)
UI take-up	Actively Seeking	−0.118	(0.138)	−0.118	(0.223)
DI application	ζ_1^D			2.065	(1.066)
DI application	ζ_2^D			0.746	(0.165)
DI application	ζ_3^D			0.148	(0.015)
UI take-up	ζ_1^U			2.496	(3.843)
UI take-up	ζ_2^U			0.847	(0.481)
UI take-up	ζ_3^U			0.334	(0.072)
Log LH		-6923.97		-6873.71	

NOTES. – Source: SIPP panels 1990-2001 matched to SSA's administrative records on disability insurance applications and awards. The part "DI application" refers to the hazard of applying for DI, while the part "UI take-up" refers to the take-up decision of UI benefits. All models are estimated for the first 24 months of duration. Block bootstrapped standard errors with 100 repetitions and states as blocks are shown. All dollar values are deflated to January 1990 values and expressed in thousand of dollars. Past earnings are highest yearly earnings for the year of and the year before job loss. Information on yearly earnings are obtained from the Detailed Earnings Records (DER).

Variables besides those shown in the table: age, age squared; male; high-school graduate; white; married; spouse works; spell is second of more spell of person; household size; number of children under 18; health (good, medium, fair and poor; reference: excellent); Activities of Daily living (problems with one, two, three, or four or more; reference: no problems); Functional Limitations (one, two, three, four or more; reference: no limitations); whether person was in a hospital during last year; whether person has health insurance; U.S. divisions; calender years.

Table 2.9: Hazard Model Estimates: Duration-specific effects

		(1)		(2)	
Part	Regressors	Coeff.	SE	Coeff.	SE
DI application	Work Limitation	0.328	(0.111)	0.298	(0.155)
DI application	Past Monthly Earnings	−0.047	(0.128)	−0.051	(0.084)
DI application	Monthly Earnings (spouse)	−0.077	(0.040)	−0.092	(0.050)
DI application	Spell has Extended Benefits	−1.126	(0.133)	−1.102	(0.200)
DI application	Maximum UI benefit duration	−0.099	(0.038)	−0.114	(0.050)
DI application	Unemployment Rate	0.920	(3.512)	−0.321	(5.384)
DI application	Principal Insurance Amount	0.912	(0.257)	0.942	(0.311)
DI application	MB	−0.132	(0.283)	−0.076	(0.374)
DI application	MB x UI take-up x Duration 1	−0.497	(0.578)	−0.386	(0.635)
DI application	MB x UI take-up x Duration 2	−0.168	(0.334)	−0.085	(0.332)
DI application	MB x UI take-up x Duration 3	−0.784	(0.530)	−0.720	(0.499)
DI application	MB x UI take-up x Duration 4	−0.563	(0.460)	−0.540	(0.405)
DI application	MB x UI take-up x Duration 5	−2.070	(2.666)	−2.113	(5.383)
DI application	MB x UI take-up x Duration 6	−0.549	(0.888)	−0.631	(0.680)
DI application	MB x UI take-up x Duration 7	−1.182	(1.582)	−1.340	(2.358)
DI application	MB x UI take-up x Duration 8	−1.155	(6.186)	−1.410	(5.674)
DI application	MB x UI take-up x Duration 9+	−0.527	(0.495)	−0.760	(0.708)
DI application	UI take-up	−0.462	(0.133)	−1.290	(0.550)

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Table 2.9 (continued from previous page)

		(1)		(2)	
Part	Regressors	Coeff.	SE	Coeff.	SE
UI take-up	Work Limitation	−0.180	(0.050)	−0.184	(0.109)
UI take-up	Past Monthly Earnings	−0.058	(0.026)	−0.057	(0.031)
UI take-up	Monthly Earnings (spouse)	−0.095	(0.030)	−0.114	(0.050)
UI take-up	Spell has Extended Benefits	0.217	(0.051)	0.279	(0.150)
UI take-up	Maximum UI benefit duration	−0.098	(0.022)	−0.103	(0.057)
UI take-up	Unemployment Rate	5.522	(2.878)	6.709	(4.798)
UI take-up	MB	0.863	(0.146)	0.929	(0.325)
UI take-up	DI application	−1.206	(0.364)	−1.788	(0.634)
UI take-up	Waiting Week	−0.035	(0.140)	−0.053	(0.208)
UI take-up	Telephone Interview	0.052	(0.118)	0.045	(0.222)
UI take-up	Disability Provision	0.168	(0.137)	0.200	(0.327)
UI take-up	Suitable Work	0.079	(0.127)	0.092	(0.231)
UI take-up	Usual Work	0.068	(0.191)	0.023	(0.238)
UI take-up	Actively Seeking	−0.118	(0.146)	−0.116	(0.273)
DI application	ζ_1^D			0.935	(0.375)
DI application	ζ_2^D			0.196	(0.031)
DI application	ζ_3^D			2.578	(1.203)
UI take-up	ζ_1^U			0.511	(0.283)
UI take-up	ζ_2^U			0.223	(0.047)
UI take-up	ζ_3^U			1.592	(3.008)
Log LH		-6923.29		-6871.83	

NOTES. – Source: SIPP panels 1990-2001 matched to SSA's administrative records on disability insurance applications and awards.The part "DI application" refers to the hazard of applying for DI, while the part "UI take-up" refers to the take-up decision of UI benefits. All models are estimated for the first 24 months of duration. Block bootstrapped standard errors with 100 repetitions and states as blocks are shown. All dollar values are deflated to January 1990 values and expressed in thousand of dollars. Past earnings are highest yearly earnings for the year of and the year before job loss. Information on yearly earnings are obtained from the Detailed Earnings Records (DER). Compensation.

Variables besides those shown in the table: age, age squared; male; high-school graduate; white; married; spouse works; spell is second of more spell of person; household size; number of children under 18; health (good, medium, fair and poor; reference: excellent); Activities of Daily living (problems with one, two, three, or four or more; reference: no problems); Functional Limitations (one, two, three, four or more; reference: no limitations); whether person was in a hospital during last year; whether person has health insurance; U.S. divisions; calender years.

Table 2.10: Hazard Model Estimates: State's Initial Application Success Rates

		(1)		(2)	
Part	Regressors	Coeff.	SE	Coeff.	SE
DI application	Work Limitation	0.334	(0.137)	0.315	(0.147)
DI application	Past Monthly Earnings	-0.049	(0.128)	-0.054	(0.122)
DI application	Monthly Earnings (spouse)	-0.079	(0.035)	-0.093	(0.064)
DI application	DI Initial Appl. Success Rate	-1.240	(0.965)	-1.374	(1.455)
DI application	Spell has Extended Benefits	-1.132	(0.134)	-1.105	(0.202)
DI application	Maximum UI benefit duration	-0.082	(0.041)	-0.095	(0.072)
DI application	Unemployment Rate	-0.500	(3.218)	-1.542	(5.838)
DI application	Principal Insurance Amount	0.907	(0.266)	0.941	(0.424)
DI application	MB	-0.003	(0.281)	0.129	(0.412)
DI application	MB x UI take-up	-1.152	(0.510)	-1.347	(0.838)
DI application	UI take-up	0.026	(0.315)	-0.659	(0.622)
UI take-up	Work Limitation	-0.180	(0.063)	-0.182	(0.139)
UI take-up	Past Monthly Earnings	-0.059	(0.027)	-0.057	(0.044)
UI take-up	Monthly Earnings (spouse)	-0.095	(0.030)	-0.114	(0.082)
UI take-up	DI Initial Appl. Success Rate	-0.475	(0.845)	-0.233	(1.385)
UI take-up	Extended Benefits	0.218	(0.055)	0.277	(0.157)
UI take-up	Maximum UI benefit duration	-0.090	(0.026)	-0.101	(0.067)
UI take-up	Unemployment Rate	5.061	(3.050)	6.579	(5.612)
UI take-up	MB	0.869	(0.154)	0.941	(0.358)
UI take-up	DI application	-1.204	(0.369)	-1.788	(0.597)
UI take-up	Waiting Time	-0.037	(0.137)	-0.055	(0.204)
UI take-up	Telephone Interview	0.056	(0.110)	0.045	(0.219)
UI take-up	Disability Provision	0.172	(0.125)	0.201	(0.278)
UI take-up	Suitable Work	0.070	(0.143)	0.090	(0.289)
UI take-up	Usual Work	0.059	(0.200)	0.022	(0.312)
UI take-up	Actively Seeking	-0.118	(0.113)	-0.118	(0.284)
DI application	ζ_1^D			0.937	(0.264)
DI application	ζ_2^D			0.260	(0.008)
DI application	ζ_3^D			2.825	(1.639)
UI take-up	ζ_1^U			0.519	(0.399)
UI take-up	ζ_2^U			0.239	(0.022)
UI take-up	ζ_3^U			1.679	(3.532)
Log LH		-6923.25		-6872.72	

NOTES. – Source: SIPP panels 1990-2001 matched to SSA's administrative records on disability insurance applications and awards.The part "DI application" refers to the hazard of applying for DI, while the part "UI take-up" refers to the take-up decision of UI benefits. All models are estimated for the first 24 months of duration. Block bootstrapped standard errors with 100 repetitions and states as blocks are shown. All dollar values are deflated to January 1990 values and expressed in thousand of dollars. Past earnings are highest yearly earnings for the year of and the year before job loss. Information on yearly earnings are obtained from the Detailed Earnings Records (DER). Compensation.

Variables besides those shown in the table: age, age squared; male; high-school graduate; white; married; spouse works; spell is second of more spell of person; household size; number of children under 18; health (good, medium, fair and poor; reference: excellent); Activities of Daily living (problems with one, two, three, or four or more; reference: no problems); Functional Limitations (one, two, three, four or more; reference: no limitations); whether person was in a hospital during last year; whether person has health insurance; U.S. divisions; calender years.

Table 2.11: Hazard Model Estimates: Division and Fixed Effects

Regressors	Coeff.	SE	Coeff.	SE	Coeff.	SE
Work Limitation	0.340	(0.291)	0.424	(0.307)	0.424	(0.321)
Past Monthly Earnings	-0.070	(0.139)	-0.048	(0.141)	-0.048	(0.166)
Monthly Earnings (spouse)	0.008	(0.120)	0.063	(0.114)	0.063	(0.106)
Spell has Extended Benefits	-0.641	(0.305)	-0.788	(0.338)	-0.788	(0.424)
Maximum UI benefit duration	0.085	(0.109)	-0.001	(0.212)	-0.001	(0.077)
Unemployment Rate	-8.093	(7.455)	5.248	(12.447)	5.248	(13.094)
Principal Insurance Amount	1.177	(0.510)	1.242	(0.544)	1.242	(0.544)
Monthly UI Benefit Amount (MB)	-1.008	(0.497)	-1.087	(0.550)	-1.087	(0.709)
Clustered SE on sample unit level	Y		Y		N	
Clustered SE on state level	N		N		Y	
State Fixed Effects	N		Y		Y	

NOTES. – Source: SIPP panels 1990-2001 matched to SSA's administrative records on disability insurance applications and awards. All models are estimated for the first 24 months of duration. Clustered standard errors on the sample unit or state level are used as indicated. All dollar values are deflated to January 1990 values and expressed in thousand of dollars. Past earnings are highest yearly earnings for the year of and the year before job loss. Information on yearly earnings are obtained from the Detailed Earnings Records (DER).

Variables besides those shown in the table: age, age squared; male; high-school graduate; white; married; spouse works; spell is second of more spell of person; household size; number of children under 18; health (good, medium, fair and poor; reference: excellent); Activities of Daily living (problems with one, two, three, or four or more; reference: no problems); Functional Limitations (one, two, three, four or more; reference: no limitations); whether person was in a hospital during last year; whether person has health insurance; whether person received worker's compensation; calender years; industry

Table 2.12: Regression estimates: Division and Fixed Effects

	Linear Probability Model				Logit Model			
Regressors	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Work Limitation	−0.011	(0.015)	−0.017	(0.017)	−0.198	(0.489)	−0.343	(0.467)
Past Monthly Earnings	0.000	(0.013)	−0.005	(0.012)	−0.049	(0.296)	−0.227	(0.292)
Monthly Earnings (spouse)	0.005	(0.006)	0.018	(0.010)	0.081	(0.183)	0.356	(0.259)
Extended Benefits	0.000	(0.029)	−0.005	(0.029)	−0.044	(0.745)	−0.226	(0.690)
Maximum UI benefit duration	0.003	(0.013)	0.005	(0.019)	0.067	(0.318)	0.023	(0.446)
Unemployment Rate	1.463	(0.806)	0.898	(0.893)	29.459	(22.247)	18.180	(27.501)
Principal Insurance Amount	0.075	(0.039)	0.076	(0.037)	1.528	(0.787)	1.740	(0.888)
MB	−0.095	(0.053)	−0.086	(0.054)	−1.860	(1.305)	−1.506	(1.160)
Division Fixed-Effects	Y		N		Y		N	
State Fixed Effects	N		Y		N		Y	

NOTES. – Source: SIPP panels 1990-2001 matched to SSA's administrative records on disability insurance applications and awards. All models are estimated for the first month for those workers who receive UI. States with too few observations are disregarded to avoid risk of disclosure. Block bootstrapped standard errors with 100 repetitions and states as blocks are shown. All dollar values are deflated to January 1990 values and expressed in thousand of dollars. Past earnings are highest yearly earnings of the year of and year before job loss. Information on yearly earnings are obtained from the Detailed Earnings Records (DER).

Variables besides those shown in the table: age, age squared; male; high-school graduate; white; married; spouse works; spell is second of more spell of person; household size; number of children under 18; health (good, medium, fair and poor; reference: excellent); Activities of Daily living (problems with one, two, three, or four or more; reference: no problems); Functional Limitations (one, two, three, four or more; reference: no limitations); whether person was in a hospital during last year; whether person has health insurance; U.S. divisions or states; calender years.

Table 2.13: Hazard Model Estimates: SUR

Part	Regressors	Coeff.	SE
DI application	Work Limitation	0.415	(0.228)
DI application	Past Monthly Earnings	-0.044	(0.173)
DI application	Monthly Earnings (spouse)	-0.073	(0.079)
DI application	Spell has Extended Benefits	-1.245	(0.224)
DI application	Maximum UI benefit duration	-0.124	(0.051)
DI application	Unemployment Rate	-1.478	(5.236)
DI application	Principal Insurance Amount	1.024	(0.526)
DI application	Monthly UI benefit amount (MB)	-0.368	(0.401)
UI take-up	Work Limitation	-0.200	(0.116)
UI take-up	Past Monthly Earnings	-0.071	(0.051)
UI take-up	Monthly Earnings (spouse)	-0.108	(0.068)
UI take-up	Spell has Extended Benefits	0.267	(0.151)
UI take-up	Maximum UI benefit duration	-0.070	(0.025)
UI take-up	Unemployment Rate	7.323	(5.131)
UI take-up	Monthly UI benefit amount (MB)	0.998	(0.268)
DI application	ζ_1^D	0.327	(0.067)
DI application	ζ_2^D	0.363	(0.050)
DI application	ζ_3^D	2.606	(0.997)
DI application	ζ_4^D	0.428	(0.084)
UI take-up	ζ_1^U	2.343	(0.894)
UI take-up	ζ_2^U	0.503	(0.028)
UI take-up	ζ_3^U	0.286	(0.132)
UI take-up	ζ_4^U	0.886	(0.333)
Log LH		-6915.64	

NOTES. – Source: SIPP panels 1990-2001 matched to SSA's administrative records on disability insurance applications and awards. The part "DI application" refers to the hazard of applying for DI, while the part "UI take-up" refers to the take-up decision of UI benefits. All models are estimated for the first 24 months of duration. Block bootstrapped standard errors with 100 repetitions and states as blocks are shown. All dollar values are deflated to January 1990 values and expressed in thousand of dollars. Past earnings are highest yearly earnings for the year of and the year before job loss. Information on yearly earnings are obtained from the Detailed Earnings Records (DER). Compensation.

Variables besides those shown in the table: age, age squared; male; high-school graduate; white; married; spouse works; spell is second of more spell of person; household size; number of children under 18; health (good, medium, fair and poor; reference: excellent); Activities of Daily living (problems with one, two, three, or four or more; reference: no problems); Functional Limitations (one, two, three, four or more; reference: no limitations); whether person was in a hospital during last year; whether person has health insurance; U.S. divisions; calender years.

Table 2.14: Hazard Model Estimates: Maximum UI Benefit Duration

		(1)		(2)	
Part	Regressors	Coeff.	SE	Coeff.	SE
DI application	Work Limitation	0.308	(0.098)	0.299	(0.199)
DI application	Past Monthly Earnings	-0.047	(0.122)	-0.050	(0.158)
DI application	Monthly Earnings (spouse)	-0.082	(0.032)	-0.093	(0.061)
DI application	Spell has Extended Benefits	-1.106	(0.115)	-1.084	(0.239)
DI application	Max. UI benefit duration	-0.186	(0.071)	-0.191	(0.127)
DI application	Unemployment Rate	-1.172	(3.124)	-2.275	(5.474)
DI application	Principal Insurance Amount	0.976	(0.265)	1.016	(0.566)
DI application	MB	-0.064	(0.285)	0.061	(0.342)
DI application	MB x UI take-up	-1.147	(0.480)	-1.345	(0.712)
DI application	UI take-up	0.013	(0.295)	-0.630	(0.958)
UI take-up	Work Limitation	-0.192	(0.058)	-0.192	(0.122)
UI take-up	Past Monthly Earnings	-0.044	(0.023)	-0.043	(0.046)
UI take-up	Monthly Earnings (spouse)	-0.095	(0.027)	-0.111	(0.088)
UI take-up	Spell has Extended Benefits	0.217	(0.057)	0.278	(0.153)
UI take-up	Max. UI benefit duration	-0.100	(0.095)	-0.093	(0.154)
UI take-up	Unemployment Rate	3.711	(3.132)	4.901	(4.686)
UI take-up	MB	0.834	(0.142)	0.900	(0.272)
UI take-up	DI application	-1.221	(0.372)	-1.753	(1.022)
UI take-up	Waiting Week	-0.118	(0.143)	-0.133	(0.275)
UI take-up	Telephone Interview	0.048	(0.112)	0.032	(0.197)
UI take-up	Disability Provision	0.080	(0.126)	0.106	(0.289)
UI take-up	Suitable Work	0.062	(0.147)	0.082	(0.254)
UI take-up	Usual Work	-0.049	(0.145)	-0.087	(0.394)
UI take-up	Actively Seeking	-0.188	(0.132)	-0.184	(0.227)
DI application	ζ_1^D			1.788	(1.288)
DI application	ζ_2^D			0.323	(0.054)
DI application	ζ_3^D			0.278	(0.050)
DI application	ζ_4^D			2.300	(1.962)
UI take-up	ζ_1^U			0.933	(0.195)
UI take-up	ζ_2^U			0.220	(0.371)
UI take-up	ζ_3^U			0.198	(0.108)
UI take-up	ζ_4^U			1.318	(0.857)
Log LH		-6916.98		-6860.17	

NOTES. – Source: SIPP panels 1990-2001 matched to SSA's administrative records on disability insurance applications and awards. The part "DI application" refers to the hazard of applying for DI, while the part "UI take-up" refers to the take-up decision of UI benefits. All models are estimated for the first 24 months of duration. Block bootstrapped standard errors with 100 repetitions and states as blocks are shown. All dollar values are deflated to January 1990 values and expressed in thousand of dollars. Past earnings are highest yearly earnings for the year of and the year before job loss. Information on yearly earnings are obtained from the Detailed Earnings Records (DER)..

Variables besides those shown in the table: age, age squared; male; high-school graduate; white; married; spouse works; spell is second of more spell of person; household size; number of children under 18; health (good, medium, fair and poor; reference: excellent); Activities of Daily living (problems with one, two, three, or four or more; reference: no problems); Functional Limitations (one, two, three, four or more; reference: no limitations); whether person was in a hospital during last year; whether person has health insurance; U.S. divisions; calender years.

Table 2.15: Elasticities for hazard to DI application

Regressors	Elasticities
Principal Insurance Amount	0.672
UI maximum duration	-0.927
MB x UI take-up	-0.094
Monthly Earnings (spouse)	-0.052

NOTES. – Source: SIPP panels 1990-2001 matched to SSA's administrative records on disability insurance applications and awards. See appendix 2.8 for details. Elasticities are based on table 2.14.

CHAPTER III

Reconciling Findings on the Employment Effect of Disability Insurance

3.1 Introduction

While employment rates for working-aged men in the 1990s and 2000s remained constant, employment rates for the men with work limitations fell throughout this time (Burkhauser et al., 2002a).[1] For instance, between 1990 and 2003, the employment rate of people with a work limitation in the March CPS declined from 34% to just above 20% (see figure 3.1).[2] During the same period, the fraction of the working-aged population receiving Social Security Disability Insurance (DI) benefits increased substantially (see figure 3.2).[3] Increased generosity as well as congressional reforms which made disability insurance accessible to a larger pool of people with health impairments are thought to be the major reason for this increase in DI enrollment.[4] In this paper, we address the question to which

[1] Correspondingly, while employment rates for women increased during the same time, employment rates for women with a work limitation remained constant.

[2] Figure 3.1 shows the employment rate during the weeks before the surveys were conducted. Therefore, the employment rates are somewhat lower as compared to Burkhauser et al. (2002a), who report the fraction of people employed at all during the last year.

[3] A similar increase has occurred for the Supplemental Security Income for the blind and disabled (SSI). Since SSI draws from a population with lower labor force attachment than those applying for DI, we restrict our attention to the role of the DI.

[4] Other reasons include an increase in the after-tax replacement rate (i.e. the ratio of past wage earnings to disability benefits), and, for women, their increase in labor force participation which resulted in a larger fraction of insured workers (Autor and Duggan, 2006).

extend the growth in DI has resulted in the declining employment rate of men with work limitations.

We develop a framework which decomposes changes in the overall employment rate of men with work limitations into changes due to the growth of the disability insurance system, and employment changes of work limited men who do not receive DI. We further distinguish between men who had applied for disability benefits but were denied benefits, and men who had never filed an application (non-applicants). This decomposition allows us to distinguish between employment decline due to higher DI participation and employment decline due to other factors. We concentrate in this analysis on men, since their employment decline has been a major focus of the current discussion, and because the secular increase in female labor force participation makes it more difficult to interpret this decomposition for women.

For the early 1990s, our results show that the increased availability of the DI program can only fully explain the employment decline of men under the assumption that beneficiaries would work like non-applicants if they were not in the program. A, possibly, more realistic assumption about their counterfactual employment rate — that they would work like denied applicants if they were not in the program — leaves half of the employment decline unexplained. The notion that other factors importantly contributed to the employment decline is further supported by the decomposition results for the mid-1990s and to early 2000s. During that time period, increased availability of the DI program can explain less than 50 percent of the overall employment decline. Consistently, employment rates for those not on DI have been declining throughout this period. Furthermore, when comparing employment and DI enrollment trends across age groups, we find that employment declined the most for men under 44 years, while the fraction of

DI beneficiaries increased the most for men 55 years or older.

We contribute to the literature by developing a framework which helps accounting for why different studies have found disparate findings regarding the employment effect of DI. Several aggregate studies have suggested that the growth in the DI program during the 1990s may account for much, if not all of the employment decline of men with work limitations. Bound and Waidmann (2002) regress changes of DI participation rates on the fraction of workers with health impairment who are not employed. Autor and Duggan (2003) provide similar cross-state regressions for the period 1979 to 1998 for high-school drop-outs, who are similarly at risk of applying for DI as workers with work limitations. In both studies, the increase in the fraction of DI participants appears to have a major negative effect on employment of men with work limitations. In contrast to these analyzes, studies that have used rejected disability insurance applicants to measure the labor market potential of beneficiaries have found that rejected applicants have low earnings and employment rates. Bound (1989) analyzes two samples of denied applicants from the 1970s. Arguing that they are similar to beneficiaries in observed and unobserved characteristics, he considers their employment rate as an estimate of how much beneficiaries would work if they had not applied for DI. He finds a low employment rate for denied male applicants of no more than 50 per cent. These results have been replicated for the same age category of men 45 years and older by von Wachter et al. (2010), who use administrative records spanning the time period 1978 to 2004. Chen and van der Klaauw (2008) find similar results using data from the Survey of Income and Program Participation (SIPP) covering the 1990s. They exploit a discontinuity in the determination process to estimate the disincentive effect for a subgroup of applicants those determination is based on vocational factors.[5] They estimate that the employment

[5]Initial Application for disability insurance follows a five-stage procedure. Vocational fac-

rate of these DI beneficiaries would have been only 20 percent higher had they not received benefits. These results have generally been interpreted as evidence that the increased availability of the DI system could have had at most a moderate effect on the employment rates of people with work limitations.

Each approach involves making assumptions that are open to some question. On the one side, Bound and Waidmann (2002) and Autor and Duggan (2003) observe only ecological correlations. It is possible, though, that men with work limitations found it increasingly difficult to work during the time period, while the DI program drew from a population with relatively low employment rates. If this were the case, the approach used by Bound and Waidmann and Autor and Duggan would overstate the effect of the increase in the availability of DI benefits on the employment of men. On the other side, Bound (1989), Chen and van der Klaauw (2008) and von Wachter et al. (2010) provide accurate estimates of the counterfactual employment rate of beneficiaries only if the application process itself does not substantially reduce employment for denied applicants. Furthermore, Bound's and Chen and van der Klaauw's results pertain to men 45 years or older.[6] While applicants younger than 45 years were very rare before the mid-1980s, the majority of the DI growth during the early 1990s has occurred among younger men (Autor and Duggan, 2003). For this group of men, employment rates of rejected applicants are much higher, suggesting a substantial disincentive effect (von Wachter et al., 2010).

We overcome limitations of these two approaches by identifying non-applicants through administrative records, and by assessing the expansion of the DI system jointly with employment rates for different application and age groups. Our results

tors are considered at the fifth stage for those applicants who have not qualified for disability insurance based on severe impairments. See Hu et al. (2001) for a description of the application process.

[6]Chen and van der Klaauw (2008) exploit discontinuities for ages 45, 50, and 55. Therefore, by construction, they estimate the average treatment effect for these age groups only.

clarify that the employment decline during the early 1990s can only be explained by the concurrent DI expansion if the marginal beneficiaries would work at rates comparable to non-applicants, were they not in the program. This seems doubtful. In addition, we extend our analysis past the period of rapid expansion of the DI program. Employment rates for men with work limitations continued to decline in the late 199s and early 2000, despite a slow down in the rate of growth of DI. This fact, alone, would seem to suggest important other factors at work.

Section 3.2 briefly discusses main features of the DI program as well as major policy changes over the last decades. In section 3.3, we develop and discuss the decomposition. Section 3.4 provides a description of the main data sources used for this study. It is followed by results (section 3.5) and concluding remarks (section 3.6).

3.2 Background

The federal government provides cash and medical benefits to the disabled through two programs, the Social Security Disability Insurance (DI) program, which was enacted in 1956, and the Supplemental Security Income (SSI) program, enacted in 1974. For both programs, successful application requires the

> (...) inability to engage in any substantial gainful activity by reason of any medically determinable physical or mental impairment which can be expected to result in death or which has lasted, or can be expected to last, for a continuous period of at least 12 months.[7]

During the 1960s and 1970s, the DI program was made accessible to a wider range of people. In 1960, individuals under the age of 50 were made eligible

[7]See See Title II of the Social Security Act, Section 223. [42U.S.C. 423], (d)(1)(A) (`http://www.socialsecurity.gov/OP_Home/ssact/title02/0223.htm`.)

for DI, and in 1965, the definition of disability was liberalized to allow those without permanent disabilities to qualify. In 1972, the waiting period required before an applicant for DI could start receiving benefits was reduced from six to five months and benefit levels were being increased. By the mid-1970s typical after-tax replacement rates reached 60 percent. In addition, the introduction of the Supplemental Security Income program (SSI) effectively eliminated the work history requirement for those without either significant assets or other sources of income.

With the increase in both the availability and generosity of the program, it is no surprise that DI rolls grew rapidly during the 1960s and 1970s, and reached 2.9 million (3 percent of the working-age population) by 1980. Total benefits paid out exceeded $15 billion, or 20 percent of benefits paid out for retirement. Concern grew during the 1970s that the Social Security Administration was losing control over the system and that many DI beneficiaries might not actually be eligible under the law. The Social Security Administration first responded to this situation both by trying to refine their regulations guiding decisions, and by negotiating agreements with various states. The consequences were quite dramatic. Award rates fell from 48.8 to 33.3 percent between 1975 and 1980, with this fall concentrated among states that had been more lenient in their decision making. Then in 1980 Congress passed legislation designed to tighten administrative control over the disability determination process in a number of ways. The 1980 law changed both the frequency and the nature of medical eligibility reviews for disability beneficiaries, and it had a discernible impact on administrative practice. The number of new awards continued to drop from 40 to 29 percent of all insured workers between 1980 and 1982. At the same time, there was a five-fold increase in the number of terminations. In two years' time, 25 percent of beneficiaries had their cases reviewed and more than 40 percent of those reviewed had their benefits ter-

minated. These stricter practices led to questions about due process. Many who had their benefits terminated during this period won reinstatement on appeal, and concern grew that many of those who did not appeal their terminations were, in fact, eligible for benefits.

Widespread criticism led Congress to further change the law in 1984. These amendments had a profound effect on the standards used to evaluate DI eligibility. First, the burden of proof was shifted onto the Social Security Administration to demonstrate that the health of beneficiaries under review had improved sufficiently to allow them to return to work. Second, a moratorium was imposed on reevaluations of the most troublesome cases — those that involved mental impairments or pain — until more appropriate guidelines could be developed. Third, benefits were continued for those whose terminations were under appeal. Fourth, more weight was given to source evidence (evidence provided by the claimant's own physician) by requiring that it be considered first, prior to the results of an SSA consultative examination. Fifth, consideration had to be given to the combined effect of all of an individual's impairments, regardless of whether any single impairment was severe enough to qualify the individual for benefits. Finally, and perhaps most important, the Social Security Administration substantially revised its treatment of mental illness, reducing the weight given to diagnostic or medical factors and emphasizing the ability of an individual to function in work or work-like settings. Further liberalization in eligibility criteria were implemented in 1988 and then again in 1991 when the Social Security Administration issued new rulings on pain that gave controlling weight to source evidence when such opinions were supported by medical evidence and were not inconsistent with other evidence in the case record. In addition, court opinions throughout the 1980s and early 1990s tended to reinforce SSA shift in favor of source opinions (Social Security Advisory Board 2001).

The application for DI benefits seem to mirror changes in eligibility standards, rising when standards were relaxed during the 1960s and early 1970s, and falling when standards were tightened in the late 1970s and early 1980s. Application rates appear to have responded more slowly to the relaxation of eligibility standards that occurred in 1984. This may have been because, given the nature of the reforms, it was some years before they were effectively implemented and before potential applicants understood how fundamentally the evaluation criteria had changed. Also, the strength of the economy during the later part of the 1980s would have discouraged applicants, while the deep recession of the early 1990s would have induced many to apply for benefits.

Since the reform in the mid-1980s, not only did the number of beneficiaries increase, but also their composition. Specifically, the share of younger workers below 45 years old has experienced the strongest relative increase between 1980 and the mid-1990s. The increased availability of the DI program and the shift towards younger beneficiaries naturally suggests that this shift in disability policy has importantly contributed much to the employment decline of people with health impairments since 1990.

3.3 Empirical Methodology

We decompose the overall change in employment rates for those experiencing a work limitation into changes within and between application categories. Consider the following decomposition of the employment rate of men with some health impairment at a time $t = 1$:

$$E_1 = W_{b,1} \cdot E_{b,1} + W_{d,1} \cdot E_{d,1} + W_{n,1} \cdot E_{n,1} \quad ,$$

where where the b, d and n subscripts index beneficiary, denied applicant and non-applicants, respectively, and E's represent first the overall employment rate of those with work limitations, and then the employment rates of those on DI, those who applied for DI benefits but were rejected and, finally, those who never applied for benefits. In this decomposition we ignore men who are currently applying for DI and former beneficiaries whose benefits were terminated. Both groups are small and do not change the empirical results. The W's represent the fractions of the population, among those identifying themselves with work limitations, in each group. The employment rate for $t = 2$ can be decomposed in the same fashion:

$$E_2 = W_{b,2} \cdot E_{b,2} + W_{d,2} \cdot E_{d,2} + W_{n,2} \cdot E_{n,2} \quad .$$

Taking the difference between the two time periods and denoting changes by Δ yields:

$$\Delta E = \Delta W_b \cdot \overline{E}_b + \Delta W_d \cdot \overline{E}_d + \Delta W_n \cdot \overline{E}_n + \overline{W}_b \cdot \Delta E_b + \overline{W}_d \cdot \Delta E_d + \overline{W}_n \cdot \Delta E_n \ , \quad (3.1)$$

where upper bars indicate averages taken over two periods. We can rewrite equation (3.1) using the fact that $\Delta W_n = -(\Delta W_d + \Delta W_b)$.

$$\Delta E = \Delta W_b \cdot (\overline{E}_b - \overline{E}_n) + \Delta W_d \cdot (\overline{E}_d - \overline{E}_n) + \overline{W}_b \cdot \Delta E_b + \overline{W}_d \Delta E_d + \overline{W}_n \Delta E_n \ . \quad (3.2)$$

Equation (3.2) is simply an accounting identify. However, if we assume that, had those who applied to DI in period 2 who would not have done so in period

1 would have had employment rates similar to the employment rates of non-applicants, then the first two terms have an economic interpretation. The first term $\Delta W_b \cdot (\overline{E}_b - \overline{E}_n)$ in the decomposition measures the effect that the growth in the fraction of men on DI contributes to the decline in the employment of those with work limitations, while the second term measures the effect that the growth in the fraction of men that are denied applicants have on the employment decline. The last three terms represent the within group employment declines. It is not clear how plausible it would be to attribute any of these components to the increased availability of DI benefits. In particular, the last of these three components reflects employment changes amongst those who never applied for DI benefits. It seems safe to assume that this component does not reflect any behavioral effect of the program.[8]

If the increased availability of the disability insurance program during the 1990s has mainly involved men who would previously have been working, then equation (3.2) accurately measures the employment effect of the disability insurance program during this time. It is seems more plausible, however, that this form of decomposition overstates the role of the DI growth, since it assumes that denied applicants and beneficiaries would have the same employment rate as non-applicants if they had not applied. While one might argue that the marginal applicant during the 1990s had a higher employment rate than the average applicant (i.e. that the expansion of the DI program drew from a population which was increasingly employed beforehand), Chen and van der Klaauw's study for the 1990s suggests that this is not the case. Furthermore, the rapid expansion of the

[8]With the expansion of DI, the size of the population of non-applicants will shrink. Presumably this should mean the remaining non-applicants are more capable of work. Thus, these compositional shifts should work in the direction of making this last term positive. To the extent that this term is negative, it would seem to clearly point to factors unrelated to the increased availability of DI contributing to the decline in the employment of the men with work limitations.

early 1990s was preceded by a severe decline in the number of beneficiaries between the late 1970s to early 1980s. As shown in figure 3.2, the fraction of men on DI topped 3.5 percent in the early to mid-1990s, but it was about 3.2 percent in 1977. Therefore, it seems unlikely that the employment rate of applicants during the expansion in the early 1990s was that different from the employment rate of applicants in the 1970s.

An alternative decomposition involves substituting out ΔW^d instead of ΔW^n in equation (3.1). We obtain then

$$\Delta E = \Delta W_b \cdot (\overline{E}_b - \overline{E}_d) + \Delta W_n \cdot (\overline{E}_n - \overline{E}_d) + \overline{W}_b \cdot \Delta E_b + \overline{W}_d \Delta E_d + \overline{W}_n \Delta E_n \ . \quad (3.3)$$

In this case, the expansion of the DI program is weighted by the difference $\overline{E}_b - \overline{E}_d$ instead of $\overline{E}_b - \overline{E}_n$. The leading term of this decomposition reflects the effect of the expansion of DI on employment if marginal beneficiaries would have had employment rates similar to denied applicants, had they not been receiving benefits, and if the application for DI itself does not reduce the employment of denied applicants.

These two decompositions help us interpret previous studies on the employment effect of DI. The approach by Bound and Waidmann (2002) and Autor and Duggan (2003) may be stated as estimating a type of the following specification:

$$\Delta E = \beta \Delta W_b + \varepsilon. \quad (3.4)$$

If there is no correlation between the other terms of the decomposition and the fraction of DI beneficiaries, then the OLS estimate $\hat{\beta}$ correctly estimates the

employment effect for the 1990s. However, if factors other than the increased availability of the DI system contributed to the employment decline, then ε and W_b in the regression of equation (3.4) will be negatively correlated, and the magnitude of $\hat{\beta}$ will be biased upwards. Autor and Duggan (2003) address this issue by using instrumental variables. They exploit changes to DI generosity due to shifts in the wage distribution. However, their IV estimates are imprecise, and the 95 percent confidence interval for men after 1984 includes the possibility that the growth of DI had no effect on employment decline.

In contrast, studies that base inference on the behavior of denied applications such as Bound (1989), Chen and van der Klaauw (2008) and von Wachter et al. (2010) estimate the average treatment effect of receiving disability insurance for beneficiaries. If the average treatment effect is small, then the difference $\overline{E}_b - \overline{E}_d$ in equation (3.3) is small as well. In this case, it would be unlikely that the increased availability of the DI program has had a strong effect on the employment rate of men with work limitations. There are two reasons why this conclusion might be wrong. First, the average treatment effect of applying for DI for denied applicants might be non-negligible (Parsons, 1991). In this case, using the employment rate of denied applicants would understate the average treatment effect of receiving disability insurance for beneficiaries. Second, Bound's and Chen and van der Klaauw's studies have estimated the disincentive effect for workers 45 years or older, whereas most of the expansion of the DI program has occurred among younger workers. For these denied applicants, von Wachter et al. (2010) finds a much higher employment rate.

3.4 Data and sample selection

Estimating the decompositions requires information about fractions of non-applicants, denied applicants, and beneficiaries, as well as their respective employment rates. We use the Survey of Income and Program Participation (SIPP), a nationally representative sample of individuals 15 years of age and older of the civilian non-institutionalized population. People are interviewed once every four months, called a wave, for two to four years. When sampling a new SIPP panel, the Census Bureau randomly groups people into four rotation groups. Starting with the first rotation group, each subsequent rotation group is interviewed one month after the previous one. When interviewed, respondents are asked to provide information about the preceding four months, which are also called reference months.

While the SIPP asks respondents about their employment situation and work limitations, it does not contain information regarding applications and application outcomes for DI. Several administrative files were used in order to identify beneficiaries, denied applicants, and non-applicants. Specifically, we use the so-called 831 files to identify applicants, and Master Beneficiary Records and Payment History Update System data to identify award decisions (see appendix A for details). These administrative files were matched to SIPP records using respondent's Social Security Number (SSN). Since people who disclose their SSN systematically differ from people who do not, we reweight the original population weights provided by Census (see for instance Raghunathan, 2004) before selecting those respondents who disclosed their SSN. The administrative records are not available for SIPP panels 1986 to 1989. Therefore, our analysis is restricted to the SIPP panel 1984 and SIPP panels 1990s and later.

We restricted out sample to men between 25 and 61 years who report a work

limitation. We eliminate men under the age of 25 because very few such individuals apply for DI and over the age of 61 because such men would be eligible for Social Security Retirement benefits. We limit our-self to men who identify themselves as suffering from some kind of work limitation because men who experience no such limitations are very unlikely to either apply for DI benefits or have them awarded.

For panels prior to the 1996 panel, work limitations are overreported for all waves except the first one (Maag and Wittenburg, 2003). Therefore, we only use the first wave for these panels. For the 1996 and 2001 panel, we disregard the first wave due to implementation problems. We exclude men who have been in the army, and men who have applied or are currently applying for SSI for the blind and disabled only.[9] With these restrictions, the fraction of men identified as having a work limitation remains approximately constant through the years we examine (see table 3.1). For an exact decomposition, we also disregard current applicants and men who had received DI, but those benefits had been terminated. Both groups are relatively small, and a more extensive decomposition which includes these two groups does not change the results.[10] Finally, we select the fourth reference month for each wave,[11] and use last weeks' employment status, which corresponds to the standard CPS employment measure. Details on administrative records and the sample selection are contained in appendix A.

Four waves are used for the decomposition. These are SIPP panel 1990, wave

[9]People can apply for DI and SSI for the blind and disabled simultaneously if they fulfill the respective eligibility criteria. These dual applicant or beneficiaries are not disregarded.

[10]For the sample prior to disregarding current applicants and men who had received disability insurance, the fraction of current applicants is generally between 2.5 and 5.5 percent for the waves considered, and does not show any trend. The fraction of men those benefits have been terminated increases from about 1 percent to 3 percent between the 1990 and 2004 panel, which is consistent with a decrease of terminations due to death and retirement, and an increase of terminations due to medical disqualifications since the late 1980s (Autor and Duggan, 2006).

[11]This is the month preceding the interview month, and therefore likely to be the least affected by recall bias regarding past employment status.

1, SIPP panel 1996, wave 2, SIPP panel 2001, wave 5, and SIPP panel 2004, wave 1. The fourth reference month of the first wave of the SIPP 1990 covers January through April 1990, just before the recession of 1990/1991 and the expansion of the DI program started.[12] For the 1996 SIPP panel, the fourth reference month of the second wave covers July through October 1996, which corresponds to a time where the major expansion of the early 1990s had subsided. The 2001 SIPP was conducted around and after the recession of 2001, which occurred between March and November 2001. Since DI participation growth tends to lag the unemployment rate (Rupp and Stapleton, 1995), we choose wave 5 of the 2001 panel, which corresponds to May through August of 2002. We also use the first wave of the 2004 SIPP, which covers January through April 2004, because the full effect of the recession on employment and DI participation might only appear after the 2001 panel was conducted.[13] Besides these four waves, we will use all of the selected waves to discuss some of the findings of the decomposition.

3.5 Results

Table 3.2 presents population fractions of men by applicant status, i.e. non-applicant, beneficiary, and denied applicant. At the beginning of 1990, a little bit more than two thirds of men 25 to 61 years old with a reported work limitation are non-applicants, 19 percent are beneficiaries, and 13.9 percent denied applicants. Older men are more likely to receive DI benefits, whereas the fraction of denied applicant is relatively stable across age groups. In 1996, the picture had changed quite dramatically. The fraction of non-applicants had decreased by 10

[12]Following the NBER business cycle dates, the recession of 1990/1991 started in July 1990.

[13]Results from the 2004 SIPP should be treated with caution, since the percentage of men with work limitation is noticeably higher as compared to previous panels. If the population with a work limitation in the 2004 panel is more healthy as compared to the population with a work limitation in previous panels, then both the overall employment change and the role of DI growth would be understated. The overall bias for the decomposition is therefore unclear.

percentage points to 56.9 percent. That decrease had been matched by a corresponding increase in the fraction of beneficiaries to 29.2 percent. The fraction of denied applicants had remained stable during that time.[14] When comparing population fractions among age categories, one can see that the increase in beneficiaries was mostly concentrated among men 25 to 44 years old: the percentage of beneficiaries 44 years or younger almost doubled during that time. However, in absolute terms, the increase was highest for men age 55 years and older, those participation increased from 29.7 percent to 42.6 percent. By 2002, the fraction of non-applicants had decreased even further, but only slightly to 53.4 percent. The fraction of beneficiaries had increased by another 4.2 percentage points, while the fraction of denied applicants had decreased slightly. Comparing the 1996 panel to the 2004 panel, we observe a further decline of the fraction of non-applicants to 51.8 percent, a 3.4 percentage increase in the fraction of beneficiaries, and a 1.8 percentage increase in the fraction of denied applicants.

Table 3.3 shows corresponding employment rates. The employment rate of non-applicants is 61.1 percent in 1990, whereas denied applicants have an employment rate of 34.1 percent. Beneficiaries have an average employment rate of 5.7 percent.[15] Across age groups, men 25 to 44 years have similar employment rates as men 45 to 54, but their employment rates of non-applicants and denied applicants are much lower than those of men 45 to 54. In contrast, the employment rate of beneficiaries age 25-44 is 14 percent, whereas it is less than 3 percent for beneficiaries age 45 or older. For non-applicants and beneficiaries, this pattern remains remarkably stable across most years and panels. These results imply that the difference in the employment rate of non-applicants versus beneficiaries is not

[14] It appears that an increase in the application success probability since the mid-1980s has mainly contributed to a stable fraction of denied applicants.

[15] As mentioned in section 3.2, beneficiaries are not prohibited from working fully, but may work to some extend, as long as their earnings do not exceed a certain threshold, called the "Substantial Gainful Activity" amount.

necessarily larger for younger men as compared to older men.[16]

Table 3.4 presents the results using the first decomposition (equation 3.2). For the 1990-1996 comparison, the decomposition suggests an estimated employment decline attributable to the increased availability of DI benefits that exceeds the overall employment decline if men 25 to 61 are considered. However, separate decompositions by age groups reveal that employment rates declined during that time period only for men who were 25 to 54 years old. For them, the DI growth can explain all of the decline in employment. The contribution of the DI expansion looks quite different if one considers the second decomposition (equation 3.3). Table 3.5 presents corresponding results. This decompositions suggests that For men 25 to 54 years old, the growth in DI can now only explain about half of the overall employment decline.

Decompositions for 1996 and the 2001 and 2004 panel show a much larger overall employment decline, which exceeds 10 percentage points for men who are 25 to 44 years old. No matter which decomposition is used, these dramatic employment changes are not nearly matched by a corresponding expansion of the DI program. For men 25 to 61 years old, the growth in DI for the 1996-2001 comparison can only explain between 8 and 20 percent of the overall employment decline, depending on which decomposition is used. For the 1996-2004 comparison, the DI program can explain between 30 percent and 50 percent of the overall employment decline. Even more startling are the decompositions for the three different age groups. Especially for men 25 to 44 years old, the employment decline which is attributable to the expansion of the DI program can at most explain 20 percent of the overall employment decline. Further sensitivity analyzes for the SIPP which support this finding are explained in appendix 3.8.

[16]For instance, in 1990, the difference is 46.5 percent for men 25-44 years old, but 66.9 percent for men 44-54 years old and 51.1 percent 55-61 years old.

While the SIPP data we have been working with has the distinct advantage of being matchable to data that allows us to identify those who have applied for DI benefits, there are a number of things about the data that raise concerns about the comparability of the data across time. As we have discussed, the nature of the questions that allow us to identify the disabled population has changed over time. In addition, the fraction of SIPP respondents matchable to the administrative data that allow us to identify DI applicants has declined over the years. We worked hard to make the data comparable over time, but, still, it is natural to worry about that comparability. For this reason, we turn to the CPS. Since 1988 the March Current Population Survey (CPS) has included a question to identify those with a work limitation. Over time, this questions seems to have identified a roughly constant share of the male working aged population is suffering from some kind of limitation that effects the persons capacity for work (see figure 3.3). The CPS data can not be matched to administrative data, and so can not, in the data, determine who has applied for DI or SSI benefits. At the same time, it is possible to identify those who are receiving Social Security benefits. For those under the age of 62 virtually all workers who receive Social Security benefits are receiving DI benefits. Figure 3.4 shows DI participation by age categories. It can be seen that the fraction of male DI beneficiaries who are 25-44 years old remained constant between 1995 and 2007, or even decreased slightly. Corresponding employment trends by age groups from the CPS, as shown in figure 3.5, reveal that employment rates declined the strongest among younger men between 1995 and 2008. These patterns would certainly seem to suggest that something other than the increased availability of DI benefits played an important role in the employment declines of those identified as suffering from a work limitation. Finally, figure 3.6 shows trends in employment for those in the CPS who identify themselves as limited, but do not identify themselves as receiving Social Security benefits. The CPS shows

striking employment declines amongst this group. Since the fraction of denied applicants remained constant during that time period, this employment decline can be interpreted as occurring primarily among those who never applied for DI.

Once again, we are left with the conclusion that the increased availability of DI was not the only factor contributing to the employment decline amongst those with a work limitation.

3.6 Conclusion

This study has attempted to reconcile divergent findings concerning the employment effect of the DI program. Using a decomposition strategy, we find that it is unlikely that the growth in the fraction of DI beneficiaries during the early 1990s can fully explain the employment decline. This result is substantiated by the steady employment decline during the mid-1990s to mid-2000s, with no corresponding strong increase in the fraction of beneficiaries. It therefore seems to be likely that other factors than the DI program have contributed to employment decline from 1990 to 2004. This is precisely the context in which the methods used by Bound and Waidmann (2002) and Autor and Duggan (2003) are likely to seriously exaggerate the causal role played by DI in explaining the decline in the employment of men with work limitations. Future research will have to address which other factors have led to this decline.

3.7 Appendix: Data selection

Administrative records: Applications are identified through so-called 831 files. When a person applies for DI, an 831 file is opened. It subsequently documents all application stages up to the reconsideration stage.[17] We use 831 files from 1978 onwards, which is the earliest year they are currently available. This restriction is likely to understate the number of denied applicants slightly, especially for the earlier years of the analysis.

While 831 records provide accurate information on application dates and outcomes of initial application and reconsideration, they do not record appeal decisions. However, an increasing fraction of initially denied applications have been appealed. For instance, in 2002, about one-third of all applications were decided through the appeal process. Of these, more than three quarters were successful, as opposed to only 37 percent successful initial applications (Szymendera, 2006). These successful appeals would be misclassified as denial by 831 records.

In order to improve on the accuracy of the application information of the 831 files, we augment them with the Master Beneficiary Records (MBR). The MBR contain complete application information including appeals, but only for the latest disability application. MBR records are matched to 831 files using dates of application. Furthermore, we use the Payment History Update System (PHUS) to identify successful appeals which have been erased from the MBR. The PHUS records monthly information on benefits received from 1984 onwards. They are matched to 831 files and MBR records using benefit begin dates.[18]

[17] If denied benefits at the initial determination process, applicants can ask for reconsideration. If still denied benefits, they can further appeal the decision to an Administrative Law Judge and an Appeal Board. See Benitez-Silva et al. (1999) for a detailed analysis of the appeal process.

[18] In practice, dates of filing might differ for same applications in these files. Therefore, we matched records which were filed within 50 days. PHUS records are matched to 831 or MBR records if the benefit begin date is within 100 days of the date an application decision has been reached.

Work limitation: The SIPP contains a standard work limitation question: "Does [person] have a physical, mental, or other health condition which limits the kind or amount of work [person] can do?" Before the 1996 panel, people were asked this question during the first wave, and then only for some subsequent waves which contained health and disability modules. In these modules, people who had indicated a work limitation in a previous wave were reminded of his or her affirmative response before the question was asked again.[19] With the 1996 redesign, the work limitation question was included in all core surveys, and people were not reminded of their previous response. Maag and Wittenburg (2003) show that before the 1996 redesign, the prevalence rate of work limitation increased within each panel over subsequent waves, whereas such a trend is not visible for the 1996 panel. They hypothesize that those who indicated having a work limitation in a previous wave are more likely to respond positively to the question if they were reminded about their earlier response. Figure 3.7 replicates their findings using SIPP panels 1984 to 2004 for men age 25 to 61. As can be seen, the prevalence rates generally increase within each wave before the 1996 redesign. In contrast, the 1996, 2001, and 2004 SIPP panels do not exhibit such a trend.

As a consequence of this reporting bias, it is plausible that people with work limitations are relatively more healthy for later waves than for earlier ones. Consequently, employment rates of people with work limitation are likely to be upward biased for later waves of these panel. Figure 3.8 demonstrates the effect of the recall bias on employment rates. As the fraction of men indicating a work limitation increases for SIPP panels 1984-1993, so does their employment rate. In contrast, employment rates remain stable across waves for later panels.

In order to circumvent that the recall bias with respect to the work limitation

[19]Specifically, they are asked: "We have recorded that [person]'s health limits the kind or amount of work [person] can do. Is that correct?"

question affects estimates of employment changes, we restrict our analysis to the first wave prior to the 1996 redesign. Figure 3.9 shows trends in the prevalence rates of men with work limitations, using wave one, two, and four of SIPP panels between 1984 and 2004. It illustrates that the prevalence rate remains fairly stable between 1984 and 2004 when only same waves are considered. Figure 3.10 depicts corresponding employment trends for men with work limitations. The decline in the employment rate is similar to the CPS based trend of figure 3.1, albeit it seems to have started earlier.

We also disregard the first wave of the 1996 panel, since numerous changes implemented in the 1996 SIPP redesign are likely to have affected data reporting for the first wave (see Maag and Wittenburg, 2003). As visible in figure 3.7, the work limitation prevalence rate is somewhat higher for the first wave of the 1996 SIPP panel as compared to subsequent waves. This anomaly also appears for the 2001 SIPP panel. We suspect that similar implementation issues had affected that wave, and disregard it as well. Concerning the 2004 SIPP panel, we consider the first seven waves only, because administrative records are currently available until the end of 2005.

SSN disclosure: Table 3.6 reports the percentage of men, 25 to 61 years old, who did and who did not disclose their SSN for selected waves of panels 1984 to 2004.[20] The percentage of men who disclose their SSN declines from 92% for the SIPP 1990 to 85% for the SIPP 1996, and further to 76% for the SIPP 2004, wave 1. Moreover, the percentage is only 62% for the SIPP 2001, wave 1, and declines to just above 60% for subsequent waves of that panel. For that panel, the low percentage of disclosures had apparently be caused by Census' asking about

[20]For these tabulations, we select men as described in section 3.4, except selection based on their SSN. Therefore, table 3.6 presents accurate percentages for the sample used for the decomposition prior to selection based on SSN disclosure.

respondents' SSN through telephone interviews.

The decreasing SSN disclosure percentage poses two problems. First, since those who do not report their SSN are subsequently disregarded, a lower disclosure percentage reduces the final sample size.[21] Second, and more seriously, if men who disclose their SSN systematically differ from men who do not, than selection based on SSN disclosure can bias the results from the decomposition. Table 3.7 shows demographic and economic characteristics for selected waves of those who disclosed and those who did not disclose their SSN, respectively. Men who disclosed their SSN are more likely to be better educated, married and employed than those who did not disclose their SSN. They also tend to be more likely to report a work limitation for the 1990 SIPP panel, but they are less likely to do so for the 2001 and 2004 panel. For a given panel, these differences in observable characteristics suggest that we would overstate the employment rate among all application groups, and understate the fraction of beneficiaries and denied applicants, since these population groups are less likely to be higher educated, married, and employed. Moreover, since the percentage of men who disclose their SSN decreases over subsequent panels, we would expect these biases to become more severe for later panels. Consequently, we would obtain estimates for the increase in DI enrollment and for the decline in employment rates which are too low.

In order to correct for these biases, we reweight the original population weights provided by Census to account for non-random selection by SSN disclosure status (see for instance Raghunathan, 2004). For that, we estimate weighted logit models of SSN disclosure for each panel separately. We use the person-month weights provided by Census and include the same variables as in table 3.7, except for flexible age dummies.[22] We then divide the original weights by the predicted

[21] Leaving men who do not disclose their SSN in the sample is not an option since they would be classified as non-applicants, even though some of them are beneficiaries or denied applicants.

[22] We use the following age categories: 25-29 years, 30-34 years, 35-39 years, 40-44 years, 45-49

values in order to obtain corrected weights. This procedure eliminates the biases which result from selection on SSN if this selection, conditional on the observable characteristics, is random.[23]

3.8 Appendix: Further sensitivity analyzes for the SIPP

In order to substantiate our finding that the DI program can explain little of the employment decline in the SIPP since the mid-1990s, we combine each 1996 wave (except for the first) with a 2001 or 2004 wave (except of the first 2001 wave), carry out the first decomposition, and aggregate the results into two sources of employment changes: the employment effect due to changes in DI beneficiaries and denied applicants (the first two terms in equation 3.2), and changes in employment rates of non-applicants, beneficiaries, and denied applicants (the last three terms of equation 3.2). This procedure amounts to 88 decompositions for the 1996-2001 comparison, and 77 for the 1996-2004 comparison. For the 1996-2001 comparison, all 88 employment changes are negative and so are the total employment effects of the DI program. For the 1996-2004 comparison, the two changes have the same sign for 66 out of 77 cases, but in eleven cases, the employment change is positive while the effect of the DI growth is negative. However, as argued earlier, the results for the 2004 panel are likely to be confounded by much stronger changes in the percentage of men indicating a work limitation (see footnote 13). For those cases for which both differences are negative, the total employment effect never explains more than 50 percent of the overall employment decline.

years, 50-54 years, 55-61 years.

[23] In order to verify our supposition regarding the bias due to SSN disclosure, we compared population fractions, employment rates, and decompositions using the original person-month weights and the corrected person-month weights. The correction does increase the fraction of DI recipients and denied applicants, as well as decrease the employment rates for all applicant groups. Furthermore, these changes tend to be more severe for panels with a lower disclosure percentage. For the decomposition, we find that using the corrected weights slightly reduces the role of the expansion of the DI program in explaining the observed employment declines.

As a second way to validate the above result, we investigate the employment rate of non-applicants. If the growth in the DI program since the mid-1990s cannot explain much of the decline of the employment rate of men with work limitations, then we would expect a decrease in the employment rate of non-applicants during that time. However, using trends of employment rates from the SIPP may be misleading, since the percentage of men who report a work limitation decreased over subsequent waves for the 1996 and 2001 wave. Whether this change in self-reported work limitations is a point of concern depends on why the percentage of men who report work limitations declined. Figure 3.11 shows the percentage of men with work limitations for two categories, namely whether the respondent had participated in all waves of a panel or whether the respondent did not. Rates of men with work limitations are generally higher for those who did not participate in all waves as compared to those who did, and their rate also declines over subsequent waves. Hence, it appears that men with more serious health problems are more likely to drop out of a panel. In contrast, those who remained in a panel for all waves have a relatively stable work limitation rate for both the 1996 and the 2001 panel. The decline of the rate of men with work limitations over subsequent waves would therefore, if at all, understate the real employment decline of non-applicants, since those who drop out of the panel are likely to be more severely impaired and less likely to be employed. Figure 3.12 presents trends in employment of non-applicants by participation. The employment rate increased somewhat until the fifth wave of the 1996 panel, corresponding to the first quarter of 1997, but then decreases until wave 12, which corresponds to the last quarter of 1999. A further decline can be observed for the 2001 panel.

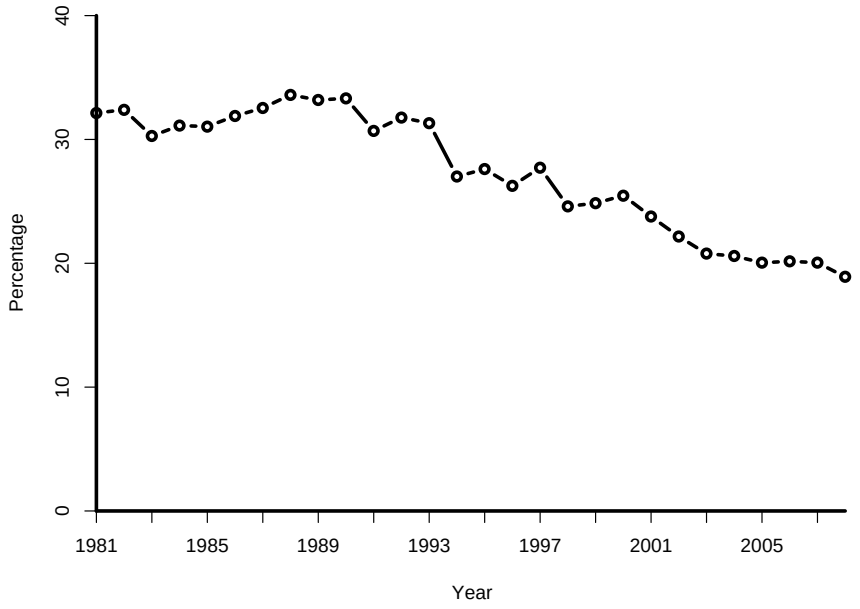

Figure 3.1: Employment rates for men, 25-61 years, who indicate a work limitation, 1981-2007.
Source: CPS March Supplement

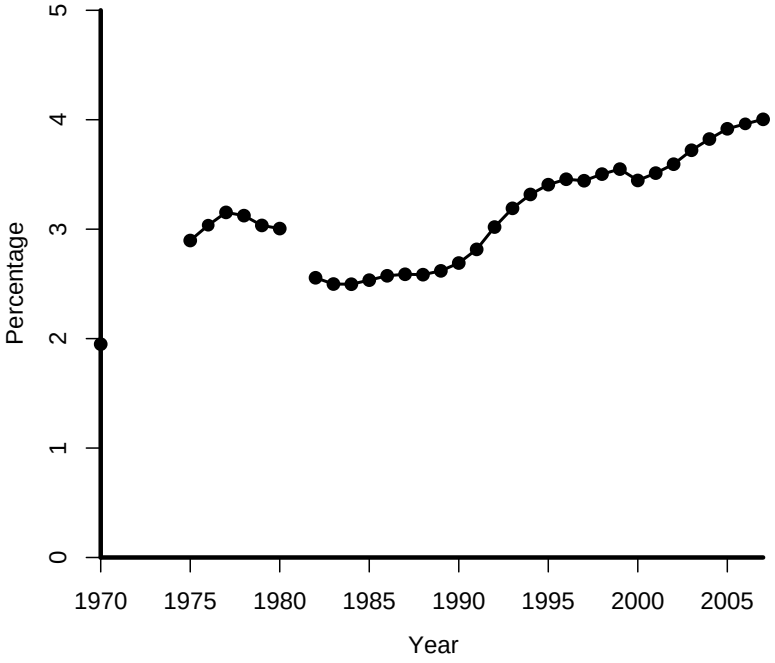

Figure 3.2: DI participation for men, 25-61 years, 1970-2007.
Source: SSA Statistical Supplement and Census

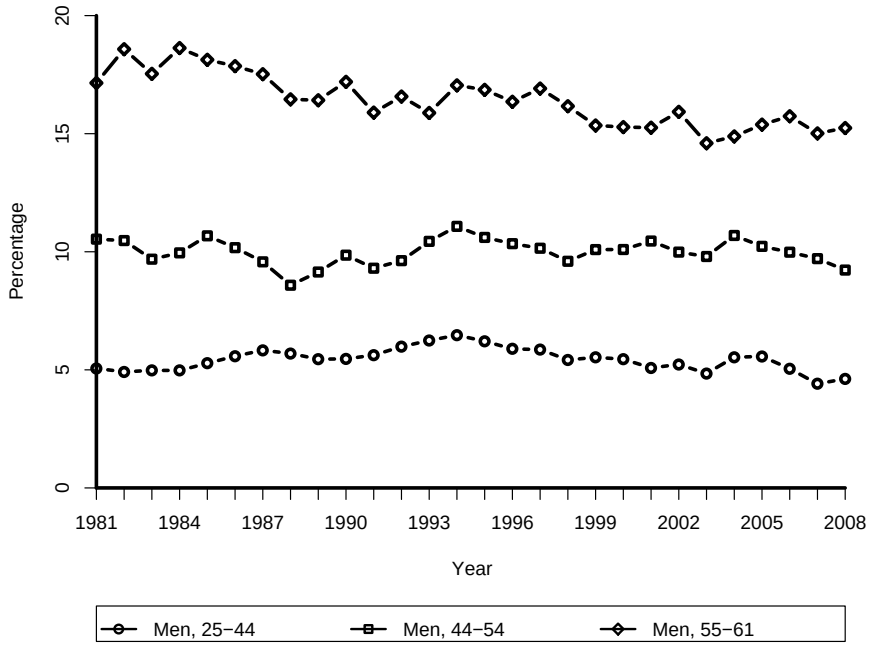

Figure 3.3: Percentage of men, 25-61 years, who indicate a work limitation (by age categories), 1981-2007.
Source: CPS March Supplement

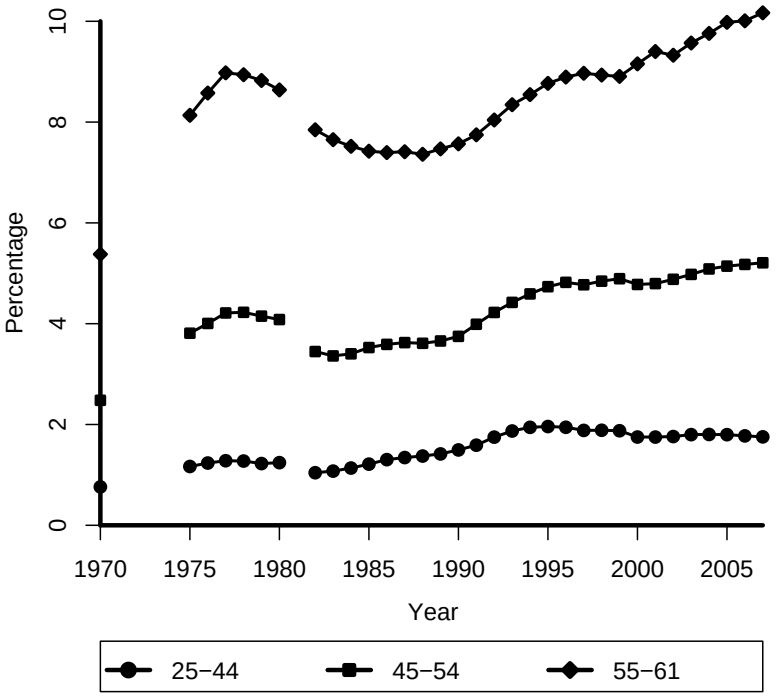

Figure 3.4: DI participation for men, 25-61 years, 1970-2007, by age categories.
Source: SSA Statistical Supplement and Census

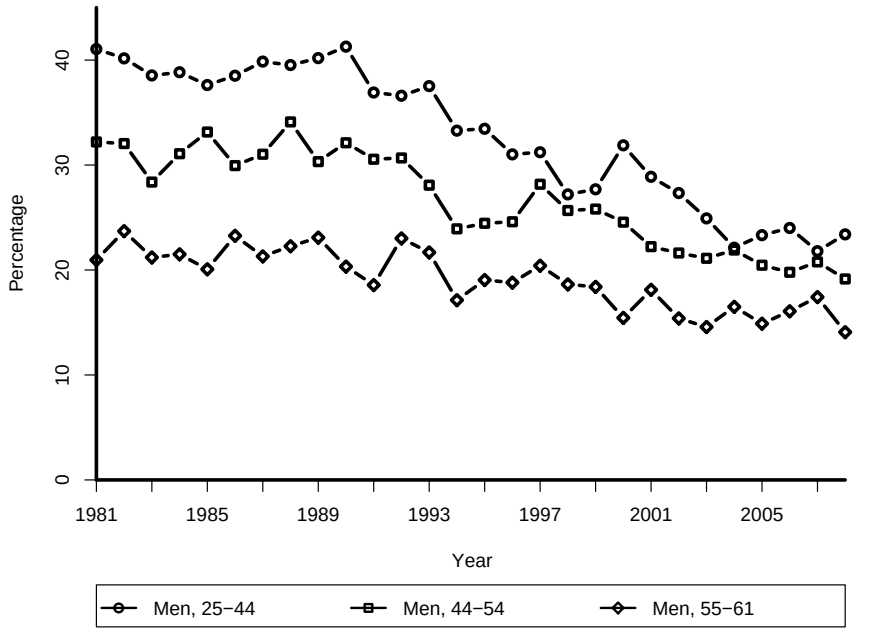

Figure 3.5: Employment rates for men, 25-61 years, who indicate a work limitation, 1981-2007.
Source: CPS March Supplement

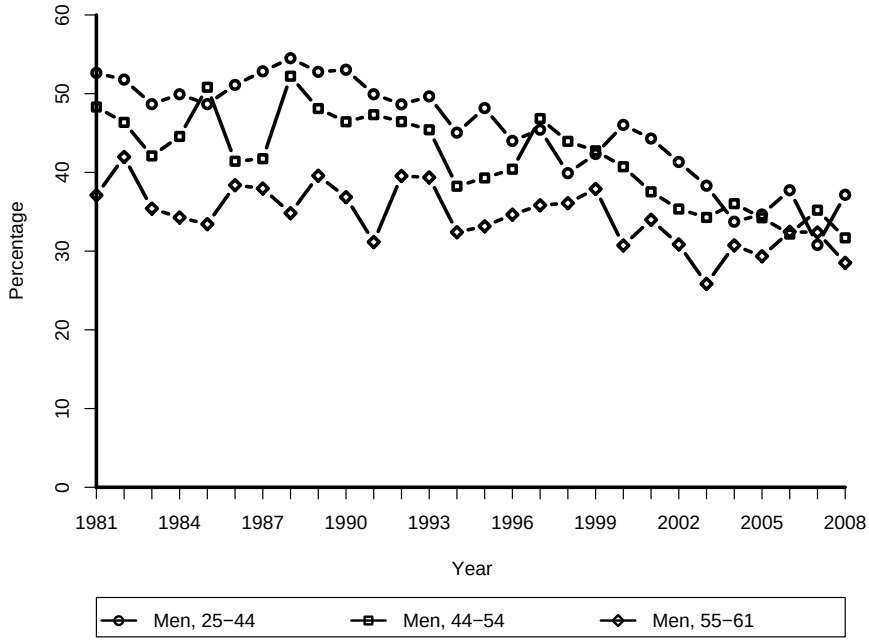

Figure 3.6: Employment rates of men, 25-61 years, who do not receive Social Security (by age categories), 1981-2007.
Source: CPS March Supplement

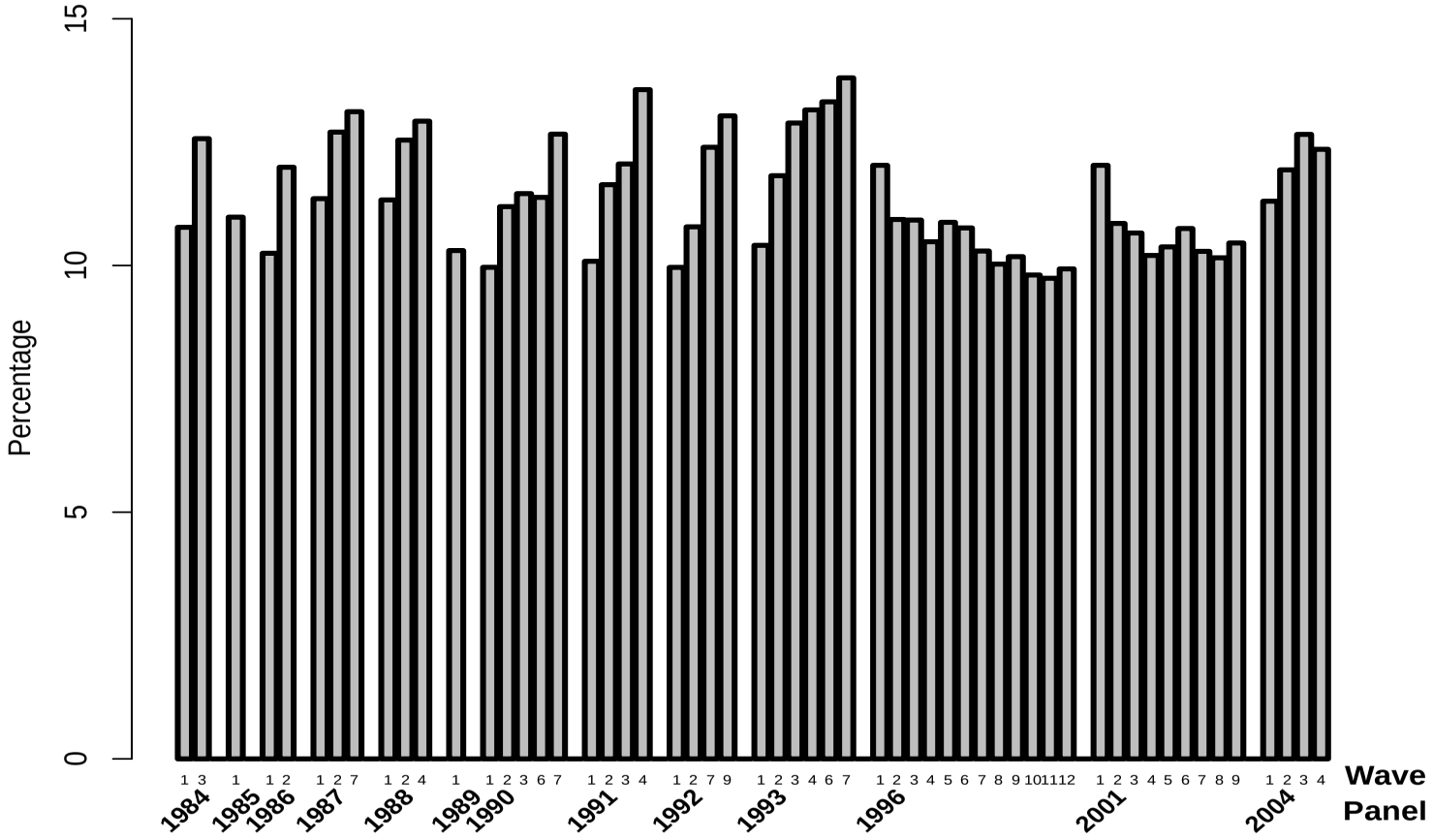

Figure 3.7: Percentage of men, 25-61 years old, who indicate a work limitation (by waves and panels).
Source: SIPP panels 1984-2004. Original person-month weights provided by Census have been used.

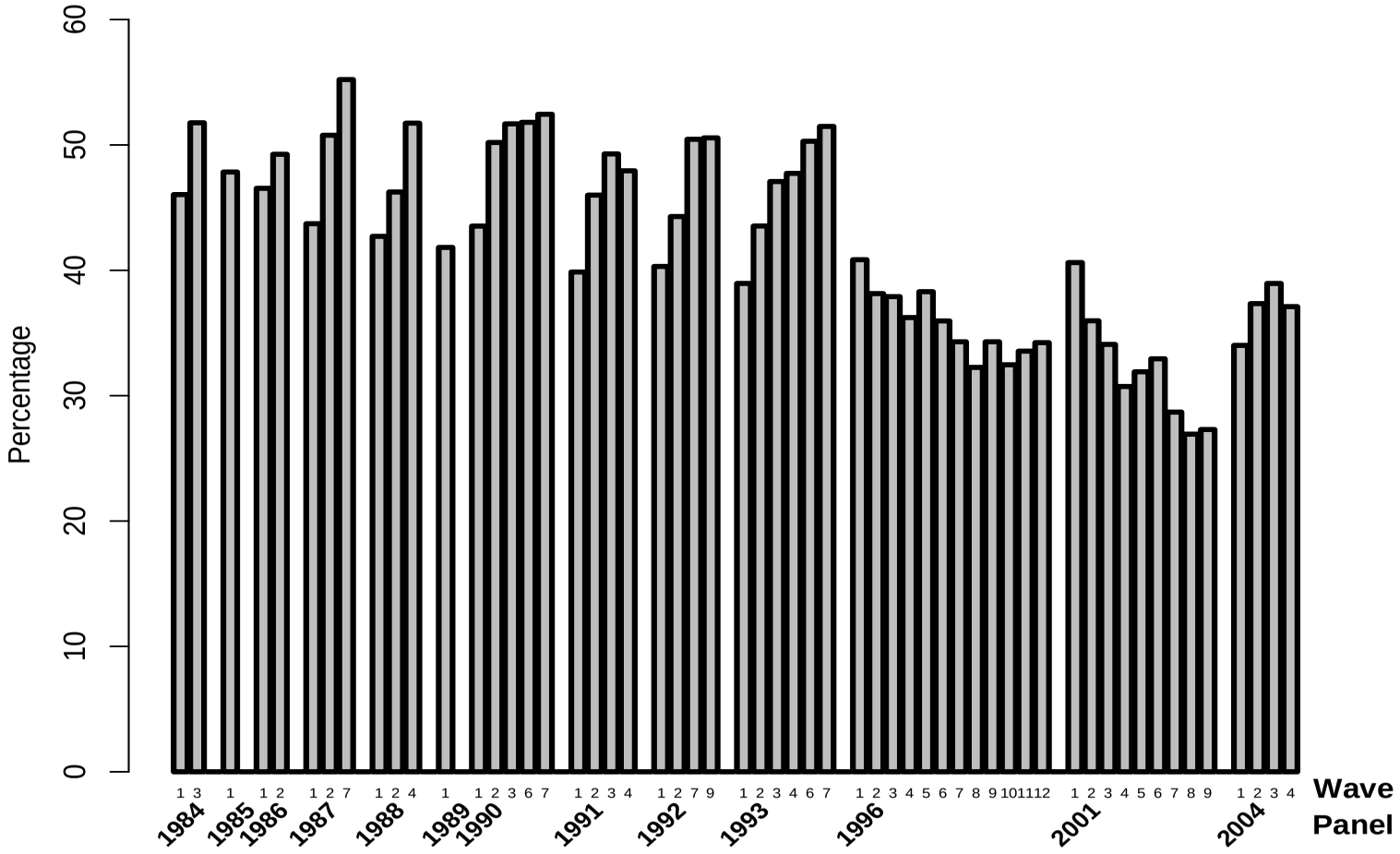

Figure 3.8: Employment rates of men, 25-61 years old, with work limitation (by waves and panels).
Source: SIPP panels 1984-2004. Original person-month weights provided by Census have been used.

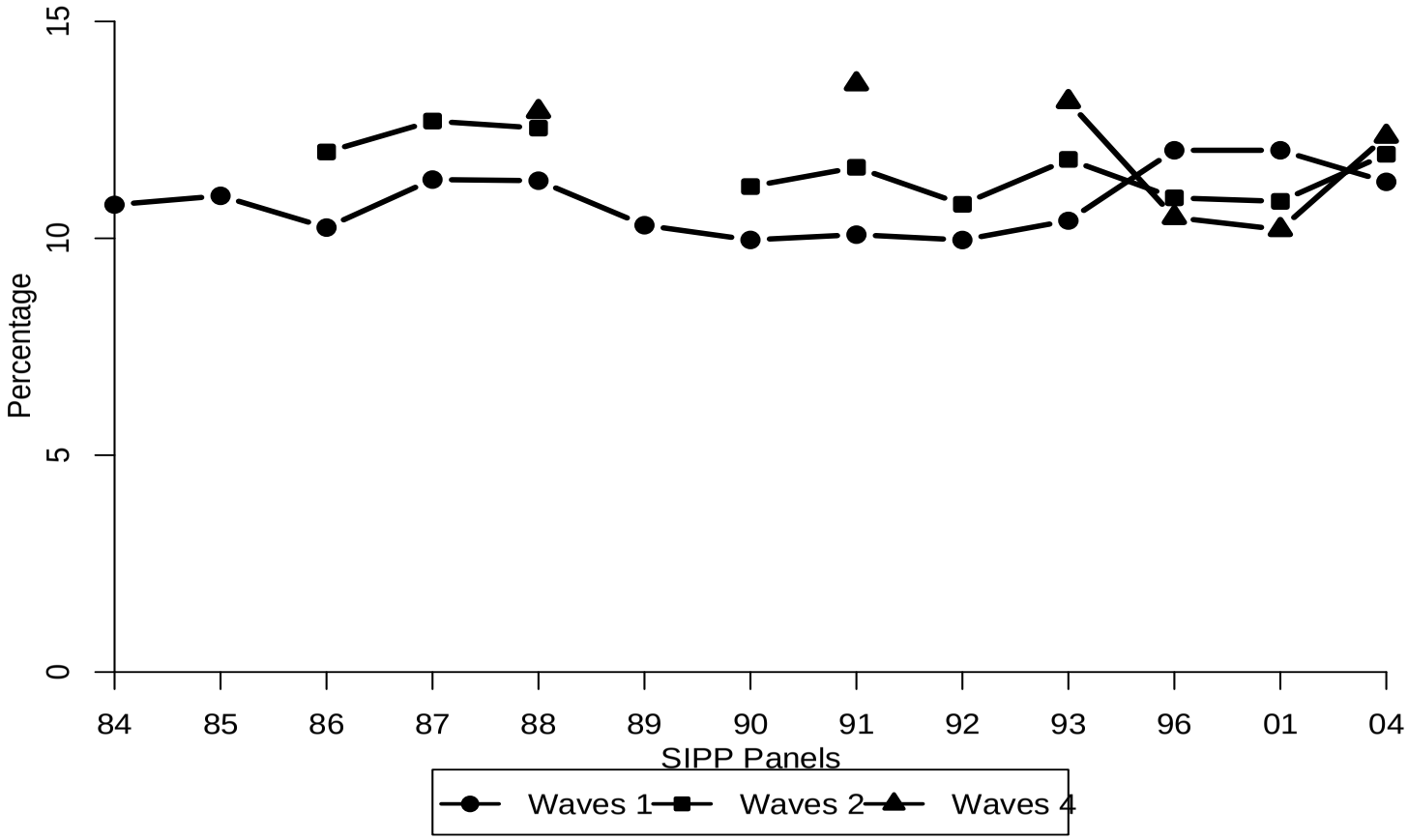

Figure 3.9: Percentage of men, 25-61 years old, who indicate a work limitation (wave 1, 2, and 4 for various panels). *Source: SIPP panels 1984-2004. Original person-month weights provided by Census have been used.*

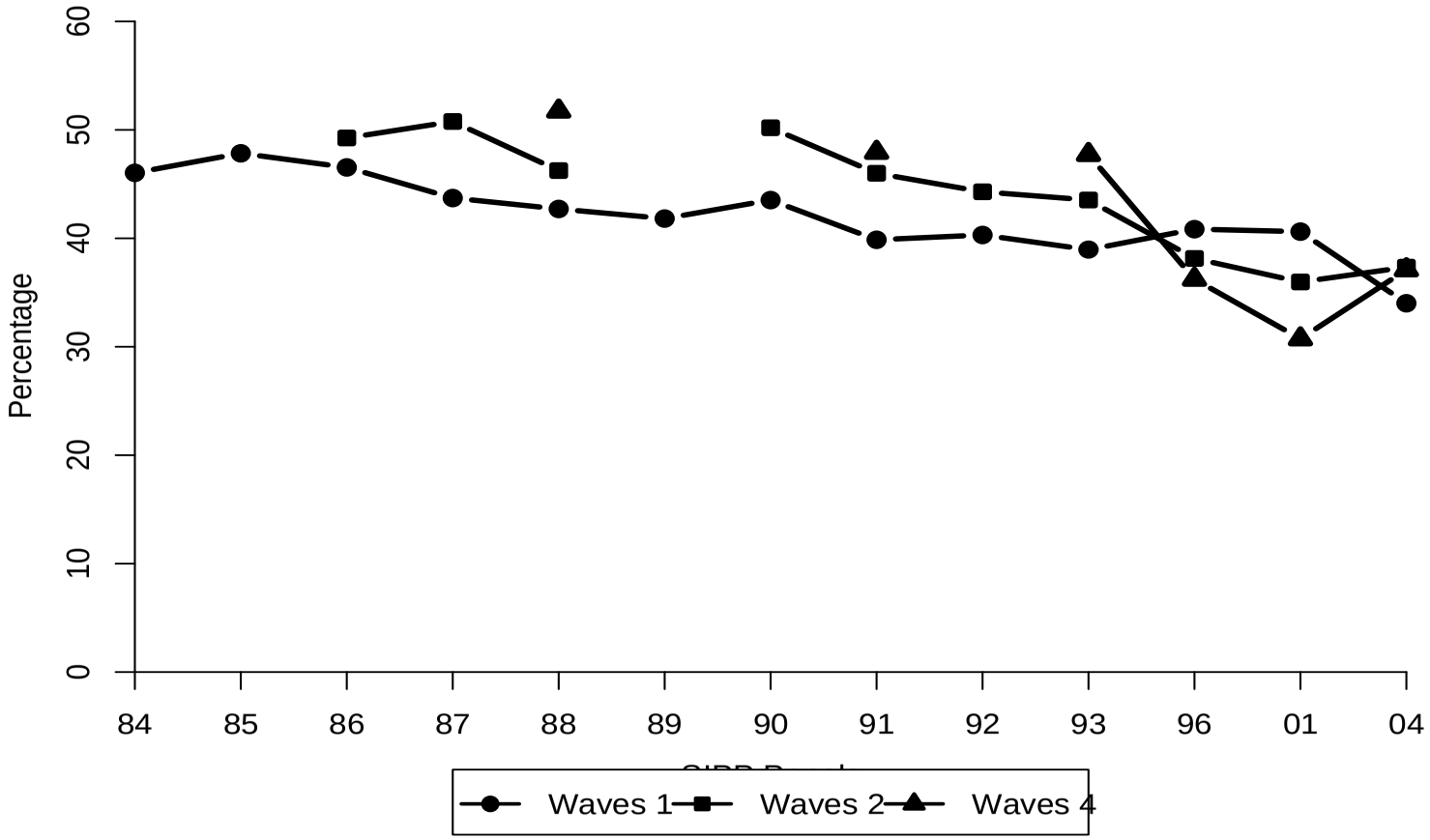

Figure 3.10: Employment rates of men, 25-61 years old, with work limitation (wave 1, 2, and 4 for various panels).
Source: SIPP panels 1984-2004. Original person-month weights provided by Census have been used.

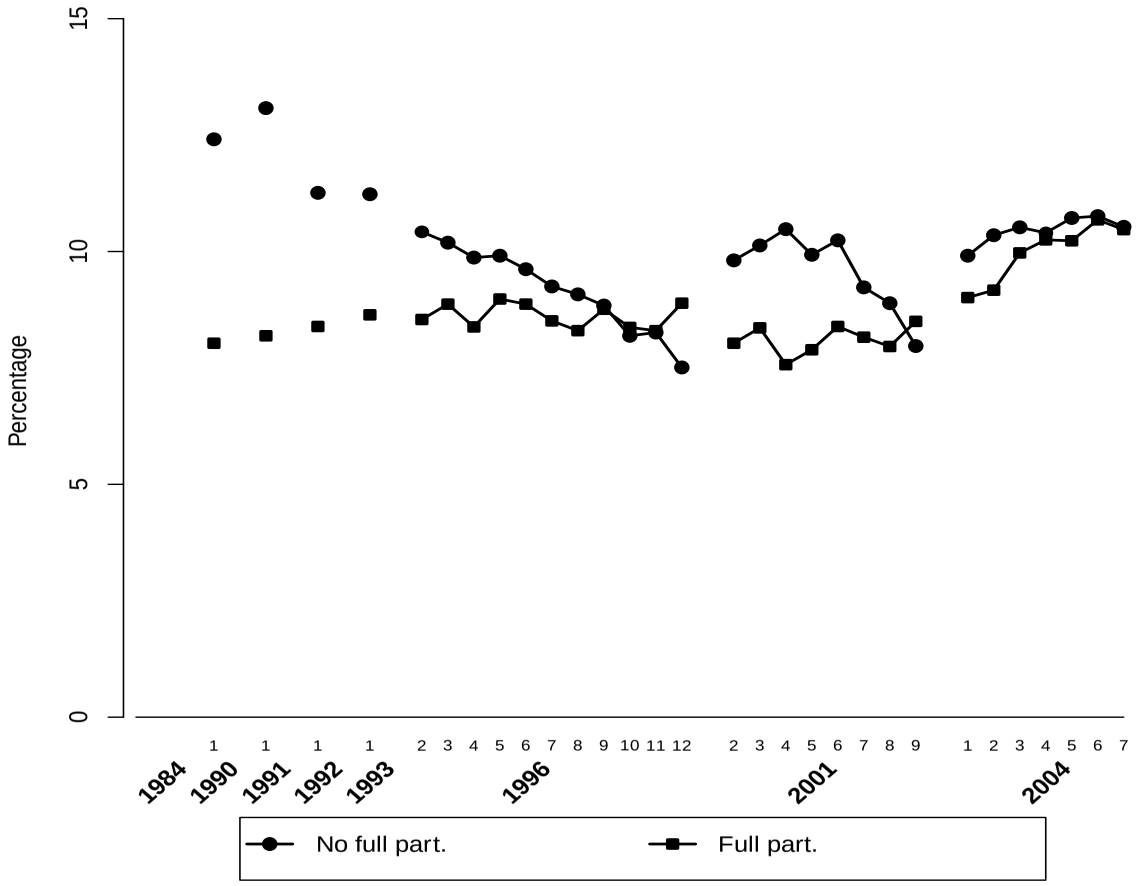

Figure 3.11: Percentage of men, 25-61 years old, who indicate a work limitation (by participation status).
Source: SIPP panels 1990-2004 matched to SSA's administrative records on disability insurance applications and awards. Corrected person-month weights have been used (details see appendix 3.7).

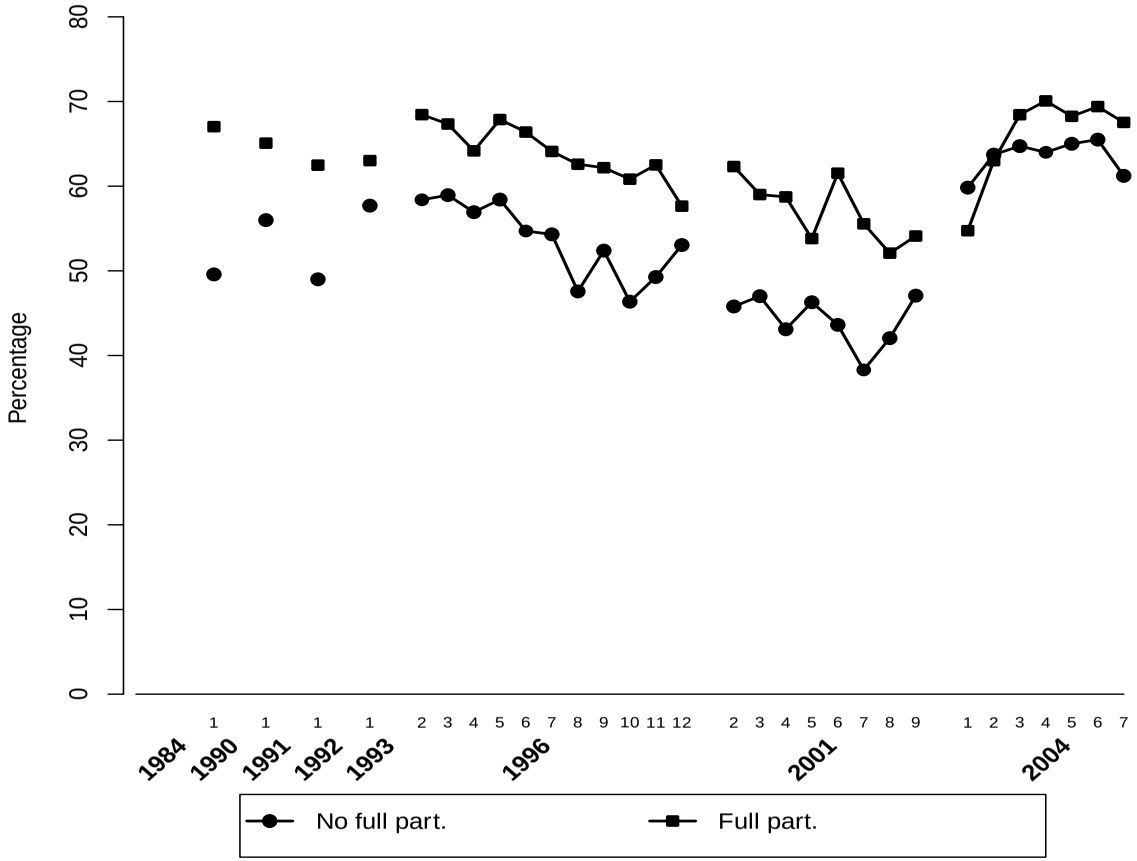

Figure 3.12: Employment rates of non-applicants 25-61 years old, with work limitation (by participation status)
Source: SIPP panels 1990-2004 matched to SSA's administrative records. Corrected person-month weights have been used (details see appendix 3.7).

Table 3.1: Percentage of Men with Work Limitations

	25-61	25-44	45-54	55-61
SIPP 1990, Wave 1	9.96	6.82	12.52	23.23
SIPP 1996, Wave 2	10.93	8.05	13.50	21.54
SIPP 2001, Wave 5	10.38	6.99	12.30	19.80
SIPP 2004, Wave 1	11.30	7.20	13.49	21.34

NOTE. – Source: SIPP panels 1984-2004. Original person-month weights provided by Census have been used.

Table 3.2: Population Fractions

	Non-Applicants		Denied Applicants		Beneficiaries	
	Percentage	N	Percentage	N	Percentage	N
SIPP 1990, Wave 1						
Men	67.1	720	13.9	139	19.0	214
Men, 25-44	75.4	368	12.9	63	11.8	58
Men, 45-54	63.9	178	16.4	38	19.8	62
Men, 55-61	57.0	174	13.3	38	29.7	94
SIPP 1996, Wave 2						
Men	56.9	904	13.8	224	29.2	475
Men, 25-44	64.9	456	13.3	99	21.8	158
Men, 45-54	54.3	286	15.0	74	30.7	157
Men, 55-61	44.0	162	13.5	51	42.6	160
SIPP 2001, Wave 5						
Men	53.4	436	13.2	110	33.4	273
Men, 25-44	61.1	186	15.8	46	23.1	71
Men, 45-54	49.9	147	13.7	40	36.4	98
Men, 55-61	46.2	103	8.8	24	45.1	104
SIPP 2004, Wave 1						
Men	51.8	1000	15.6	293	32.6	615
Men, 25-44	58.5	408	17.3	120	24.2	158
Men, 45-54	51.6	343	15.9	101	32.6	214
Men, 55-61	42.4	249	12.9	72	44.7	243

NOTE. – Source: SIPP panels 1990, 1996, 2001 and 2004 matched to SSA's administrative records on disability insurance applications and awards. Corrected person-month weights have been used (see appendix 3.7).

Table 3.3: Employment Rates

	Total	Non-Applicants	Denied Applicants	Beneficiaries
SIPP 1990, Wave 1				
Men, 25-61	46.8	61.1	34.1	5.7
Men, 25-44	52.2	60.5	38.1	14.0
Men, 45-54	53.2	69.8	49.1	2.9
Men, 55-61	32.4	53.2	11.2	2.1
SIPP 1996, Wave 2				
Men, 25-61	43.7	63.9	30.8	10.6
Men, 25-44	47.4	60.7	38.5	13.3
Men, 45-54	45.9	72.3	25.4	9.4
Men, 55-61	33.3	60.2	22.8	8.8
SIPP 2001, Wave 5				
Men, 25-61	33.6	51.2	27.4	7.8
Men, 25-44	36.4	47.9	31.2	9.7
Men, 45-54	33.9	54.1	27.9	8.5
Men, 55-61	28.8	53.9	16.1	5.6
SIPP 2004, Wave 1				
Men, 25-61	36.4	58.6	25.4	6.3
Men, 25-44	35.9	51.3	21.7	8.9
Men, 45-54	41.6	65.9	34.8	6.6
Men, 55-61	31.0	62.9	19.3	4.2

Source: SIPP panels 1990, 1996, 2001 and 2004 matched to SSA's administrative records on disability insurance applications and awards. Corrected person-month weights have been used (see appendix 3.7).

Table 3.4: Decompositions

	ΔE	$\Delta W_b \cdot (\overline{E}_b - \overline{E}_n)$	$\Delta W_d \cdot (\overline{E}_d - \overline{E}_n)$	$\overline{W}_n \Delta E_n$	$\overline{W}_b \Delta E_b$	$\overline{W}_d \Delta E_d$
1990-1996						
Men, 25-61	-3.06	-5.54	0.02	1.75	1.19	-0.47
Men, 25-44	-4.79	-4.72	-0.09	0.09	-0.12	0.05
Men, 45-54	-7.26	-7.06	0.45	1.45	1.63	-3.72
Men, 55-61	0.84	-6.57	-0.08	3.52	2.42	1.55
1996-2001						
Men, 25-61	-10.16	-2.00	0.17	-6.99	-0.88	-0.46
Men, 25-44	-10.96	-0.53	-0.50	-8.04	-0.82	-1.07
Men, 45-54	-12.03	-3.10	0.47	-9.48	-0.29	0.36
Men, 55-61	-4.48	-1.24	1.76	-2.82	-1.43	-0.75
1996-2004						
Men, 25-61	-7.33	-1.80	-0.58	-2.87	-1.31	-0.78
Men, 25-44	-11.46	-1.07	-1.03	-5.78	-1.02	-2.57
Men, 45-54	-4.29	-1.16	-0.33	-3.39	-0.88	1.46
Men, 55-61	-2.27	-1.19	0.23	1.18	-2.03	-0.46

Source: SIPP panels 1990, 1996, 2001 and 2004 matched to SSA's administrative records on disability insurance applications and awards. Corrected person-month weights have been used (see appendix 3.7).

Table 3.5: Alternative Decompositions

	ΔE	$\Delta W_b \cdot (\overline{E}_b - \overline{E}_d)$	$\Delta W_n \cdot (\overline{E}_n - \overline{E}_d)$	$\overline{W}_n \Delta E_n$	$\overline{W}_b \Delta E_b$	$\overline{W}_d \Delta E_d$
1990-1996						
Men, 25-61	-3.06	-2.48	-3.04	1.75	1.19	-0.47
Men, 25-44	-4.79	-2.47	-2.34	0.09	-0.12	0.05
Men, 45-54	-7.26	-3.39	-3.22	1.45	1.63	-3.72
Men, 55-61	0.84	-1.49	-5.16	3.52	2.42	1.55
1996-2001						
Men, 25-61	-10.16	-0.83	-1.00	-6.99	-0.88	-0.46
Men, 25-44	-10.96	-0.30	-0.73	-8.04	-0.82	-1.07
Men, 45-54	-12.03	-1.02	-1.61	-9.48	-0.29	0.36
Men, 55-61	-4.48	-0.31	0.83	-2.82	-1.43	-0.75
1996-2004						
Men, 25-61	-7.33	-0.69	-1.69	-2.87	-1.31	-0.78
Men, 25-44	-11.46	-0.46	-1.64	-5.78	-1.02	-2.57
Men, 45-54	-4.29	-0.44	-1.05	-3.39	-0.88	1.46
Men, 55-61	-2.27	-0.31	-0.65	1.18	-2.03	-0.46

Source: SIPP panels 1990, 1996, 2001 and 2004 matched to SSA's administrative records on disability insurance applications and awards. Corrected person-month weights have been used (see appendix 3.7).

Table 3.6: Disclosure of Social Security Numbers

Panel	Wave	SSN non-disclosure		SSN disclosure	
		Percentage	N	Percentage	N
1984	1	13.58	1578	86.42	10011
1990	1	7.90	1048	92.10	11590
1991	1	11.31	929	88.69	7562
1992	1	11.50	1236	88.50	10214
1993	1	12.26	1360	87.74	10239
1996	2	15.20	2971	84.80	16996
1996	3	15.08	2896	84.92	16535
1996	4	15.27	2837	84.73	15956
1996	5	15.17	2755	84.83	15383
1996	6	15.17	2649	84.83	14861
1996	7	15.24	2597	84.76	14396
1996	8	15.47	2625	84.53	14224
1996	9	15.47	2563	84.53	13971
1996	10	15.39	2517	84.61	13746
1996	11	15.49	2516	84.51	13600
1996	12	15.75	2578	84.25	13597
2001	2	37.86	6234	62.14	10280
2001	3	38.78	6178	61.22	9876
2001	4	38.64	6088	61.36	9685
2001	5	39.43	6122	60.57	9415
2001	6	39.51	6170	60.49	9343
2001	7	39.77	6138	60.23	9244
2001	8	39.94	6071	60.06	9046
2001	9	40.19	5940	59.81	8783
2004	1	23.65	5231	76.35	20021
2004	2	21.09	4374	78.91	19093
2004	3	20.19	4049	79.81	18428
2004	4	19.31	3813	80.69	18093
2004	5	18.23	3531	81.77	17840
2004	6	17.16	3281	82.84	17636
2004	7	16.06	3081	83.94	17471

NOTE. – Source: SIPP panels 1984-2004 matched to SSA's administrative records on disability insurance applications and awards. Table entries are for men, 25-61 years old. We exclude from the sample: (i) men who have been in the military; (ii) men who have applied or are currently applying only for SSI; and (iii) men who are currently applying for DI/SSI or who were beneficiaries for DI. Details concerning sample selection see appendix 3.7. Original person-month weights provided by Census have been used to compute percentages.

Table 3.7: Demographic characteristics by SSN disclosure

	1990, Wave 1			1996, Wave 2			2001, Wave 5			2004, Wave 1		
	no SSN	SSN	test stat.[1]	no SSN	SSN	test stat.[1]	no SSN	SSN	test stat.[1]	no SSN	SSN	test stat.[1]
Age	40.58	40.11	0.58	40.04	40.94	−2.85	41.43	42.36	−3.11	39.81	42.98	−9.33
HS graduates	82.56	83.83	1.07	83.09	88.87	79.10	88.05	90.04	14.93	79.63	91.92	658.93
Some college	41.78	47.22	11.16	33.61	40.57	50.80	39.90	43.27	17.12	36.42	51.14	359.34
Married	63.10	68.73	13.95	58.53	68.00	101.56	61.93	66.39	32.23	50.46	69.02	629.16
Work limited	7.04	9.38	5.91	9.41	9.43	0.00	9.29	8.33	4.01	12.68	8.93	65.90
Employed	84.89	87.01	3.50	84.09	88.33	42.01	82.57	86.67	48.72	77.96	86.81	253.77
Empl. if work lim.	38.30	47.20	1.96	36.86	44.52	5.32	26.13	38.10	21.67	26.34	40.18	42.88

NOTE: – Source: SIPP panels 1990, 1996, 2001 and 2004 matched to SSA's administrative records on disability insurance applications and awards. Table entries are percentages except for the mean of age. Data source is SIPP panels 1984-2004 matched to administrative records. Table entries are for men, 25-61 years old. We exclude from the sample: (i) men who have been in the military; (ii) men who have applied or are currently applying only for SSI; and (iii) men who are currently applying for DI/SSI or who were beneficiaries for DI. Details concerning sample selection see appendix 3.7. Original person-month weights provided by Census have been used to compute percentages and means.

[1] t-statistic (for mean differences) or chi-square (for proportions) is used.

BIBLIOGRAPHY

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Angrist, Joshua D. (2001): Estimation of Limited Dependent Variable Models with Dummy Endogenous Regressors: Simple Strategies for Empirical Research. *Journal of Business Economics Statistics*, vol. 19(1): 2–28.

Autor, David H. and Mark G. Duggan (2003): The Rise in the Disability Rolls and the Decline in Unemployment. *Quarterly Journal of Economics*, vol. 118(1): 157–205.

——— (2006): The Growth in the Social Security Disability Rolls: A Fiscal Crisis Unfolding. *Journal of Economic Perspectives*, vol. 20: 71–96.

Benitez-Silva, Hugo, Moshe Buchinsky, Hiu Man Chan, Sofia Cheidwasser, and John Rust (2004): How Large is the Bias in Self-reported Disability? *Journal of Applied Econometrics*, vol. 19(6): 649–670.

Benitez-Silva, Hugo, Moshe Buchinsky, Hiu Man Chan, and Sofia Sheidvasser (1999): An Empirical Analysis of the Social Security Disability Application, Appeal, and Award Process. *Labour Economics*, vol. 6(2): 147–178. Yale University.

Black, Dan, Kermit Daniel, and Seth Sanders (2002): The Impact of Economic Conditions on Participation in Disability Programs: Evidence from the Coal Boom and Bust. *American Economic Review*, vol. 92(1): 27–50.

Borghans, Lex, Anne C. Gielen, and Erzo F.P. Luttmer (2010): Social Support Shopping: Evidence from a Regression Discontinuity in Disability Insurance Reform. IZA DP NO. 5412.

Bound, John (1989): The Health and Earnings of Rejected Disability Insurance Applicants. *American Economic Review*, vol. 79(3): 482–503.

Bound, John, Richard J. Burkhauser, and Austin Nichols (2003): Tracking the Household Income of SSDI and SSI Applicants. In: Polachek, Solomon W. (Ed.), *Worker Well-being and Public Policy*. Amsterdam: JAI, pp. 113–148.

Bound, John and Richard V. Burkhauser (1999): Economic Analysis

of Transfer Programs Targeted on People with Disabilities. In: Ashenfelter, Orley. and David Card (Eds.), *Handbook of Labor Economics*, vol. 3, chap. 51. Elsevier.

Bound, John and Timothy Waidmann (2002): Accounting for Recent Declines in Employment Rates among Working-Aged Men and Women with Disabilities. *Journal of Human Resources*, vol. 37(2): 231–250.

Bratsberg, Bernt, Elisabeth Fevang, and Knut Red (2010): Disability in the Welfare State: An Unemployment Problem in Disguise? IZA Working Paper No. 4897.

Burkhauser, Richar V., Mary C. Daly, Andrew Houtenville, and Nigar Nargis (2002a): Self-Reported Work-Limitation Data: What They Can and Cannot Tell Us. *Demography*, vol. 39(3): 541–555.

Burkhauser, Richard V., J.S. Butler, and Robert R. Weathers II (2002b): How Policy Variables Influence the Timing of Applications for Social Security Disability Insurance. *Social Security Bulletin*, vol. 64(1): 52–83.

Burkhauser, Richard V., Butler J. S., and Gulcin Gumus (2004): Dynamic Programming Model Estimates of Social Security Disability Insurance Application Timing. *Journal of Applied Econometrics*, vol. 19: 671–685.

Card, David, Raj Chetty, and Andrea Weber (2007): Cash-on-Hand and Competing Models of Intertemporal Behavior: New Evidence from the Labor Market. *Quarterly Journal Economics*, vol. 122(4): 1511–1560.

Chen, Susan and Wilbert van der Klaauw (2008): The work disincentive effects of the disability insurance program in the 1990s. *Journal of Econometrics*, vol. 142: 757–784.

Chetty, Raj (2008): Moral Hazard versus Liquidity and Optimal Unemployment Insurance. *Journal of Political Economy*, vol. 116: 173–234.

Currie, Janet (2004): The Take-Up of Social Benefits. UCLA Working Paper.

Duggan, Mark, Perry Singleton, and Jae Song (2007): Aching to Retire? The Rise in the Full Retirement Age and its Impact on the Disability Rolls. *Journal of Public Economics*, vol. 91: 1327–1350.

Dynarski, Susan and Jonathan Gruber (1997): Can Families Smooth Variable Earnings? *Brookings Papers on Economic Activity*, vol. 1997(1): 229–303.

Gruber, Jonathan (1997): The Consumption Smoothing Benefits of Unemployment Insurance. *American Economic Review*, vol. 87(1): 192–205.

Halpern, Janice and Jerry A. Hausman (1986): Choice under Uncertainty: A Model of Applications for the Social Security Disability Insurance Program. *Journal of Public Economics*, vol. 31(2): 131–161.

Heckman, James J. (1979): Sample Selection Bias as a Specification Error. *Econometrica*, vol. 47(1): 153–161.

Heckman, James J. and Burton Singer (1984): A Method for Minimizing the Impact of Distributional Assumptions in Econometric Models for Duration Data. *Econometrica*, vol. 52(2): 271–320.

Hu, Jianting, Kajal Lahiri, Denton R. Vaughan, and Bernard Wixon (2001): A Structural Model of Social Security's Disability Determination Process. *Review of Economics and Statistics*, vol. 83(2): 348–361.

Jaeger, David A. (1997): Reconciling the Old and New Census Bureau Education Questions: Recommendations for Researchers. *Journal of Business and Economic Statistics*, vol. 15(4): 300–309.

Joint Economic Committee (2010): *Extending Unemployment Insurance Benefits: The Cost of Inaction for Disabled Workers*. U.S. Congress.

Kreider, Brent (1998): Workers Applications to Social Insurance Programs when Earnings and Eligibility are Uncertain. *Journal of Labor Economics*, vol. 16(4): 848–877.

——— (1999): Social Security Disability Insurance: Applications, Awards, and Lifetime Income Flows. *Journal of Labor Economics*, vol. 17(4): 784–827.

Lahiri, Kajal, Jae Song, and Bernard Wixon (2008): A Model of Social Security Disability Insurance Using Matched SIPP/Administrative Data. *Journal of Econometrics*, vol. 145(1-2): 4–20.

Lando, Mordechai E., Mlacom B. Coate, and Ruth Kraus (1979): Disability Benefit Applications and the Economy. *Social Security Bulletin*, vol. 42: 3–10.

Lindner, Stephan (2011): Ho Does Unemployment Insurance Affect the Decision to Apply for Social Security Disability Insurance? Working Paper.

Low, Hamish and Luigi Pistaferri (2010a): Disability Risk, Disability Insurance and Life Cycle Behavior. NBER Working Paper No. 15962.

——— (2010b): Wage Risk and Employment Risk over the Life Cycle. *American Economic Review*, vol. 100(4): 1432–1467.

Maag, Elaine M. and David Wittenburg (2003): Real Trends or Measure-

ment Problems? Disability and Employment Trends from the Survey of INcome and Program Participation. Urban Institute.

McCall, Brian P. (1996): Unemployment Insurance Rules, Joblessness, and Part-Time Work. *Econometrica*, vol. 64(3): 647–682.

Meyer, Bruce D., Wallace K.C. Mok, and James X. Sullivan (2008): The Under-Reporting of Transfers in Household Surveys: Its Nature and Consequences. University of Chicago Working Paper.

NYDL (2010): *Unemployment Insurance: Information for Claimants*. New York State Department of Labor.

Parsons, Donald (1991): The Health and Earnings of Rejected Disability Insurance Applicants: Comment. *American Economic Review*, vol. 81(5): 1419–1426.

Raghunathan, Trivellore E. (2004): What Do We Do with Missing Data? Some Options for Analysis of Incomplete Data. *Annual Review of Public Health*, vol. 25(1): 99–117.

Rupp, Kalman and David Stapleton (1995): Determinants of the Growth in the Social Security Administration's Disability Programs – An Overview. *Social Security Bulletin*, vol. 58(4): 43–70.

Strand, Alexander (2002): Social Security Disability Programs: Assessing the Variation in Allowance Rates. ORES Working Paper Series Number 98. Social Security Administration.

Sullivan, Daniel and Till von Wachter (2009): Job Displacement and Mortality: An Analysis Using Administrative Data. *Quarterly Journal of Economics*, vol. 124(3): 1265–1306.

Szymendera, Scott (2006): Social Security Disability Insurance (SSDI) and Supplemental Security Income (SSI): Proposed Changes to the Disability Determination and Appeals Processes. Tech. rep., Congressional Research Service.

von Wachter, Till, Jae Song, and Joyce Manchester (2010): Changes in the Economic Outcomes to Allowed and Denied Applicants in Social Security Disability Insurance from 1978 to 2004: An Analysis using Longitudinal Administrative Records. *Forthcoming, American Economic Review*.