CHARACTERISTICS AND EMPLOYMENT OF APPLICANTS FOR SOCIAL SECURITY DISABILITY INSURANCE OVER THE BUSINESS CYCLE

Stephan Lindner and Clark Burdick

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Center for Retirement Research at Boston College
Hovey House
140 Commonwealth Avenue
Chestnut Hill, MA 02467
Tel: 617-552-1762   Fax: 617-552-0191
http://crr.bc.edu

Stephan Lindner is a research associate at the Urban Institute. Clark Burdick is a senior economist at the U.S. Social Security Administration (SSA). The research reported herein was pursuant to a grant from the SSA funded as part of the Retirement Research Consortium. The findings and conclusions expressed are solely those of the authors and do not represent the views of SSA, any agency of the federal government, the Urban Institute, or Boston College. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of the contents of this report. Reference herein to any specific commercial product, process or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply endorsement, recommendation or favoring by the United States Government or any agency thereof. The authors would like to thank Gregory Acs, Pamela Loprest, and seminar participants at the Urban Institute for helpful comments.

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Abstract

We use administrative records of the universe of applicants between 1991 and 2008 provided by the U.S. Social Security Administration to study how the composition of applicants for Social Security Disability Insurance (SSDI) changes with short-term fluctuations in the unemployment rate, and how such changes relate to their earnings and employment. We use fixed effect models to examine how applicants' characteristics, earnings and employment change with the unemployment rate and decomposition methods to investigate how changes in applicants' characteristics versus economic conditions affect their earnings and employment.

This paper found that:

- Almost all of the increase in applications and allowances for SSDI due to a higher unemployment rate is from people whose applications are either initially rejected or determined by vocational factors.
- Despite this compositional change toward applicants with a higher work capacity, we find a slightly negative relationship between post-application earnings and employment of denied applicants and the unemployment rate.
- Decomposing changes of post-applicants earnings and employment between recession and non-recession years reveals a strong negative effect of recessions that is only partly offset by the compositional shift toward applicants with higher work capacity.

The policy implications of the findings are:

- Compositional changes of applicants towards those with higher work capacity, if caused by economic conditions, may not necessarily imply that the disincentive effect of the program increases.
- Financial support and employment services could be an effective alternative to applying for DI. However, reintegrating potential SSDI applicants into the labor market may require substantial training and support, especially during recessions.

Introduction

The number of applications and awards for Social Security Disability Insurance (DI) increase with the unemployment rate (Rupp and Stapleton, 1995). Figure 1 displays this relationship for applications for the years 1991 to 2008. These stylized facts have prompted concerns that, during recessions, DI draws people with moderate disabilities out of the labor market who temporarily struggle to find employment but may be able to find valuable work once the recession is over.[1] If so, then temporary assistance programs would be better suited for these people to reintegrate them into the labor market. Yet very little is known about whether applicants during economic downturns are different from those who apply during good economic times, and how such compositional changes could relate to applicants' employment prospects.[2]

In this paper, we use administrative records of the universe of all people who apply for DI between 1991 and 2008 to examine how their composition changes during boom and busts. We find that almost all of the increase in the number of total applications and allowances during recessions is due to an increase in applications that are initially rejected at the second or fourth stage of initial determination. Because of appeals and re-applications, a sizable fraction of these additional applicants eventually manage to get into the program. The share of applicants and beneficiaries who jointly apply for Supplemental Security Income (SSI) also increases with the unemployment rate. Because SSI is a means-tested program, this finding implies that a greater share of applicants have low incomes and assets at the time of application.

We then examine how earnings and employment of applicants change over the business cycle. Based on Bound (1989), we use earnings and employment of denied applicants as a proxy for earnings and employment of all applicants if they were not in the program. Our analysis reveals that denied applicants who apply when the unemployment rate is high have higher earnings and employment in the past, but lower earnings and employment during the years shortly before and after application. These findings suggest the possibility of two opposing effects determining earnings and employment differences of applicants over the business cycle. On the one hand, applicants who apply during recessions are less disabled and therefore have higher earnings and employment in the past as compared to other applicants. On the other hand,

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[1] See for instance, see: http://usatoday30.usatoday.com/news/opinion/editorials/story/2012-02-02/disability-Social-Security-recession/52940278/1 (last accessed 03/25/2013).
[2] One exception is Coe and Rutledge (2013), who investigated changes in the composition of applicants for DI between 2000 and 2010 using various population surveys.

they apply during difficult economic times and therefore struggle more to find valuable employment around the time they apply for DI. This interpretation also helps explain the found compositional changes over the business cycle. Because of the first effect, people who apply during economic downturns are more likely to be rejected because they lack a severe health impairment or because they can perform past work, but because they struggle in the labor market, they are also more likely to be eligible for SSI when applying for DI.

To further understand the role of changing applicants' characteristics versus economic conditions, we decompose earnings and employment changes between recession and non-recession years of denied applicants five years after application into these two components. Changes in characteristics of applicants by themselves would imply that denied applicants who apply during a recession have higher earnings and employment five years after application than denied applicants who apply during a non-recession period. However, the negative effect of difficult macroeconomic conditions outweighs this positive effect, resulting in the observed negative relationship between the unemployment rate and earnings or employment five years after application.

The rest of the paper is organized as follows. We first briefly describe the DI program and discuss related literature and hypotheses. We then explain the data and methodology used for this study, followed by a presentation of the main results, discussion and concluding remarks.

An Overview of the DI Program and Its Application Process

DI is the largest federal insurance program against loss of income due to a disability. Since its inception in 1956, the number of beneficiaries has steadily increased from 150,000 in 1957 to 8.6 million in 2011, interrupted only by a slight decrease during the mid-1980s when Congress passed changes that tightened program eligibility rules (Bound and Waidmann, 2002; Social Security Administration, 2012).

Applicants for DI can also apply for SSI if they pass that program's income and asset test.[3] Applications for DI are determined by a five-stage procedure. At the first two stages, applicants with too high earnings (stage 1) and no severe health impairment (stage 2) are rejected.

[3] The current asset limit is $2,000 for individuals and $3,000 for couples. Assets include accessible resources such as defined-contribution retirement accounts, but excludes a claimant's house or car. The income limit depends on a claimant's sources of income. It is required that the claimant would qualify for some dollar amount of SSI to meet the income test. See: http://www.worksupport.com/topics/ssifaq.asp#qualify (last accessed 03/25/2013).

At the third stage, applicants with a health impairment included in a list of specific medical conditions are allowed.[4] This list includes severe medical conditions such as blindness, epilepsy, or inoperable tumors. If the applicants' health impairment is not on this list, then at stage 4 the case worker examines whether the applicant can do work he or she has done in the past. If so, the claim is denied; if not, the application moves to step 5, where the applicants' residual work capacity is evaluated.

For the subsequent analysis, we treat information about the determination stage as an indicator for a person's level of disability and work capacity. At one extreme, claimants whose applications rejected at stage 2 or 4 are likely to have less severe disabilities and a higher work capacity than other applicants. At the other extreme, claimants whose application is allowed at stage 3 arguably suffer from more severe disabilities than other claimants. Finally, claimants whose application is determined at stage 5 fall somewhere in between.

Denied applicants can ask Social Security to reconsider their case, and almost all of them do so. For instance, in 2005 45.8 percent of all initially denied applicants appealed at the reconsideration stage (Autor and Duggan, 2010). However, only a small minority of them (13 percent in 2005) are awarded benefits at this stage. Those still not awarded benefits can further appeal the decision to the administrative law judge, appeal council, and federal court level. The majority of all denials that reach the administrative law judge level are reversed (69 percent in 2005), but the waiting time for decisions at this level often extends from several months to even over a year. Only a small number of claimants rejected at this stage further appeal the decision, and most of them are not successful. Overall, the average processing time of an application is around six months, but the lengthy appeals process implies that a small fraction of applications are not determined even two to three years after applications.

Related Literature and Hypotheses

Conceptually, our study builds on Autor and Duggan (2003). They distinguish between applicants who apply for DI irrespectively of economic circumstances because of a severe health impairment and applicants who have some kind of health impairment that may qualify them for DI, but who do not consider applying for benefits as long as they have work. Once they lose

[4] For the list of medical conditions, see: http://www.ssa.gov/disability/professionals/bluebook/AdultListings.htm (last access 03/25/2013).

their job, however, applying for DI is more attractive for them than trying to find a new job. These group are called "conditional applicants" because they apply for DI only conditional on losing their job. Autor and Duggan then show that reforms in the mid-1980s have likely increased the fraction of applicants that fall in this group of conditional applicants.

In a recent paper, von Wachter, Song, and Manchester (2011) find that this shift toward conditional applicants has affected average earnings and employment of DI claimants. As in Bound (1989), they use earnings and employment of denied applicants two years after application as an upper bound for the hypothetical earnings and employment of beneficiaries if they were not in the program. Extending Bound's analysis from the late 1970s, they document changes to the composition of applicants between 1978 and 2006 and find that applications from people ages 30 to 44 have become increasingly common. Because younger denied applicants have higher earnings and employment two years after application than their older counterparts, they conclude that average employment and earnings of denied applicants and of beneficiaries if they were not in the program has increased over time.

Our study applies Autor and Duggan's framework to the business cycle. Because job losses occur more frequently during recessions, we expect that the share of conditional applicants increases during economic downturns. However, displaced workers (i.e., workers who are permanently laid off due to their firm's failure or plant closure) suffer from severe and long-term earnings losses (e.g., Ruhm, 1991; Jacobson, LaLonde, and Sullivan, 1993). Moreover, these earnings losses are greater during economic downturns when macroeconomic conditions are dire (Davis and von Wachter, 2011). Therefore, a greater share of conditional applications during recessions does not necessarily imply that average employment and earnings of applicant increases during such times.

This discussion has several testable implications for characteristics and earnings of applicants. Table 1 summarizes these hypotheses. Similar to von Wachter, Song, and Manchester (2011), we expect that younger people apply more frequently during economic downturns, which implies a negative relationship between the unemployment rate and average age of applicants. For education attainment, we hypothesize that conditional applicants have a higher level of education than other applicants because severity of a disability tends to be negatively related to educational attainment. However, it is also possible that applying for DI after job loss is a more attractive option for less educated workers than for highly educated workers because they would receive higher DI benefits relative to future earnings. The relationship between the unemployment rate and educational attainment of applicants is therefore not clear.

Predictions for joint DI/SSI applications is also unclear. On the one hand, compositional changes toward less disabled applicants imply a negative relationship of joint DI/SSI applications and the unemployment rate. This is because people with less severe disabilities tend to have higher income and assets. On the other hand, if the negative consequences of losing a job are more pronounced during economic downturns, then more applicants who apply during a recession might qualify for SSI.

In terms of initial determination, we expect that the number and share of applications determined at stages 2, 4, and 5 rises during economic downturns. By contrast, we think that the *number* of applications determined at stage 3 is unrelated to the unemployment rate. Because diagnosis groups such as musculoskeletal impairments and mental disorders are typically determined at stages 2, 4, and 5, we also expect the share of applications from these diagnosis groups to increase with the unemployment rate. By contrast, diagnosis groups such as circulatory impairments or neoplasms are typically determined at stage 3 and we therefore anticipate that the number of applications from these groups does not vary much over the business cycle.

Changes in applicants' characteristics and changes in economic conditions are also likely to affect earnings and employment of applicants. Specifically, we expect average earnings and employment during the years *before* application to be positively related to the unemployment rate, reflecting compositional changes toward applicants with less severe disabilities. However, the relationship between earnings or employment during the years *after* application and the unemployment rate is ambiguous because the negative effect of a job loss is more severe during economic downturns.

A final set of hypotheses concerns the application process, i.e., application duration and determination. If more conditional applicants apply during economic downturns and their applications are determined at later stages of the application process (e.g., stage 5), then this changing composition will also result in a longer application duration and fewer cases being allowed. However, it is possible that case workers process claims differently during recessions and booms. For instance, it may take them longer to process a claim during a recession because they have a large number of claims. It is also plausible that they process each claim quicker in such circumstances. Concerning determinations, case workers might be more lenient during difficult economic times if they think that denied applicants will struggle in the labor market, or they might be more strict if they believe that more fraudulent claims are filed. Altogether, the relationship between the unemployment rate and application duration and determination is unclear.

Data

Our primary data source is the Disability Research File (DRF). The Social Security Administration creates the DRF file by combining several administrative records related to DI applications (831 files, MBR records, etc.) with the goal of providing researchers with accessible, consistent, and comprehensive information about DI applicants. The DRF contains the beginning date, duration, and outcome of applications. It also has information about the stage of initial determination based on detailed reason of determination recorded in the 831 files (Wixon and Strand, 2013). Because the initial earnings test is not recorded in the administrative files used for the DRF, only applicants who pass the first stage of initial application are included. Basic demographic information as recorded in administrative files is included in DRF as well. In creating the DRF, SSA also matches application records to yearly summary earnings for the years 1980 to 2010.

Based on this information, we create a number of variables for our analysis. These are:

- Characteristics of applicants: age, sex, classified as being white, educational attainment (high-school drop-out, high-school graduate, college graduate), whether they apply jointly for DI and SSI, determination stage of initial application, and diagnosis groups as defined by RAND's manual (neoplasms, diseases related to endocrine systems and nutrition, blood diseases, mental disorder and retardation, nervous disorders and diseases related to the senses, circulatory diseases, respiratory diseases, digestive disease, genito-urinary diseases, diseases related to the skin, and other diagnosis groups).[5]
- Application outcomes: stage of initial determination, application duration, outcome of initial determination, and final application outcome.

[5] See Panis et al. (2000).

- Earnings: earnings (including zero earnings) and employment (defined as any positive earnings during one year) 10 years before to five years after application.
- Other information: state of applicant, state unemployment rate, and state population age 20 to 64.

For our analysis, we primarily use data that covers applications from 1991 to 2008. DRF files prior to 1991 do not exist, and DRF records after 2008 have a growing percentage of open applications as well as right-censored earnings for some of the years following application. However, we extend our analysis to the years 2009 and 2010 as a robustness check. DRF records after 2010 are currently not available. We include all adult applicants between the ages of 18 to 65, or a total of 22.7 million applications.

Based on individual-level filing dates, we create time series with quarterly and yearly frequencies by states. We aggregate individual application data for three main reasons: first, the unemployment rate is measured at the state level and therefore, linear individual-level or state-level regressions produce the same estimates for the unemployment rate as explanatory variable as long as state-level regressions are weighted by the number of applicants per state and time (Solon, Haider, and Wooldridge, 2013); second, estimating models with state-level panel data is much faster than using all individual records; and third, we can calculate aggregate-level outcomes (such as the number of applications for various types of applicants) to examine both the share of applicants and the number of applicants from such groups in one, coherent framework.

We use yearly frequencies for earnings and employment because they are only observed on an annual basis. For applicants' characteristics, we also experimented with month as frequency, but found that higher frequencies do not add any benefit to our analysis. For each frequency, we calculate characteristics of applicants who apply during the respective quarter or year. For earnings, we include past earnings up to 10 years before and up to five years after the year of application. All earnings are expressed in 2010 values using the CPI-U. This panel is then matched to population numbers to express the number of applications as population percentages.

A large number, about 30 percent, of our applications are re-applications. If re-applications vary systematically over the business cycle, they could influence the results. For instance, conditional applicants might be more inclined to re-apply but stay out of the labor force during subsequent re-applications. Therefore, their future earnings after first application are partially lower because they are in the middle of another application. To address this issue, we identify re-applications within five years after application and calculate averages for future earnings and employment without considering earnings and employment of those in the process of a re-application.

Similar to von Wachter, Song, and Manchester (2011), we also include future determinations of re-applications for the following five years to determine the final outcome of an application. Specifically, if an application is rejected but the person successfully re-applies within five years, then the original application is treated as a successful application.[6] After creating the panel for all applicants, we create two more panels for denied and accepted applicants. We use the extended definition of application outcome to create state-panels of accepted and denied applicants.

Methodology

Aggregate-level Regressions

To establish the relationship between the unemployment rate and characteristics of applicants, we specify the following models:

$$y_{st} = \beta_0 + \beta_1 ue_{st} + \eta_s + \eta_t + \eta_s \cdot t + \varepsilon_{st} \tag{1}$$

where y_{st} denotes outcomes of interest (e.g., age of applicants, percentage of applicants without a high-school degree, etc.) per time period *t* and in state *s*, ue_{st} is the unemployment rate, η_s are state fixed-effects, η_t are year fixed effects, $\eta_s \cdot t$ are state-specific linear time trends and ε_{st} is the error term. Including both state fixed effects and state fixed effects interacted with a linear time trend controls for level and long-term trend differences across states.[7] The coefficients β_1 measures the association between short-term fluctuations in the unemployment rate and applicants' characteristics.

[6] In their study, von Wachter, Song, and Manchester (2011) use re-applications for the next 10 years to distinguish between accepted and denied applicants. We compare employment and earnings estimates of rejected male applicants in 1997 as found in our study to results presented by von Wachter, Song, and Manchester (2011) in appendix Table 1. Employment rates (i.e., percent positive earnings) are lower in our sample as compared to their, especially for younger applicants. One reason for this discrepancy is the longer time horizon von Wachter, Song, and Manchester use for re-applications (10 years versus 5 years). Presumably, some of the denied applicants with low labor force attachment in our sample successfully re-apply 6 to 10 years after initial application and are therefore not included in the sample of denied applicants by von Wachter, Song, and Manchester. Median positive annual earnings are fairly similar in the two studies.

[7] See for instance Hellerstein and Morrill (2011) for a similar approach in the context of divorce risk over the business cycle.

Aside from applicants' characteristics, we also examine the relationship between the unemployment rate and application outcomes (i.e., application duration, acceptance at initial and final determination). For these outcomes, however, it is important to also control for applicants' characteristics because characteristics might change with the unemployment rate and also affect application outcomes. For instance, if more conditional applicants apply during economic downturns, then this compositional change in itself implies a negative relationship between the unemployment rate and acceptance rates. We control for such confounding factors by including applicants' characteristics as additional controls:

$$y_{st} = \beta_0 + \beta_1 ue_{st} + \gamma x_{st} + \eta_s + \eta_t + \eta_s \cdot t + \varepsilon_{st} \quad (2)$$

where x_{st} are characteristics of applicants who apply in state *s* at time *t*. We present all regression results for the level of dependent variables to measure marginal effects of short-term changes in the unemployment rate on the outcome of interest. We report all level results in basis points, i.e. the number of applications per 10,000 people. We also report regression results using the log of the outcome variable to obtain semi-elasticities. For all regressions, we use weights equal to the number of applicants in a state as fraction of all applications in one period *t*. As mentioned above, we use weighted regressions because we want to estimate descriptive statistics for the application population (Solon, Haider, and Wooldridge, 2013). Finally, we cluster standard errors at the state level to account for correlated error terms within states.

Decomposition

For the decomposition, we use semi-parametric decomposition methods similar to Barsky et al. (2002) and DiNardo, Fortin, and Lemieux (1996). We prefer this approach over parametric approaches because it does not require different model specification depending on the type of outcome variable (i.e., continuous versus binary).

We write average earnings or employment for denied applicants who apply at time *t* as follows:

$$\overline{y_t} = \int (y \mid X = x, T = t) \cdot dF(x|T = t), \quad (3)$$

where $\overline{y_t}$ are average earnings or employment of denied applicants at time *T*=*t*, (*y*|*X*=*x*,*T*=*t*) are earnings or employment conditional on observable characteristics *X* at a time *t*, and *F*(*x*|*T*=*t*) is the cumulative distribution function over values of *x* for these individuals.

The fundamental idea of any decomposition method is to add and subtract a term that measure the outcome of one group if they had the same characteristics of another group. For semi-parametric decompositions, this involves replacing the conditional outcome function of one time period or group with the conditional outcome function of another time period or group. For instance, by replacing the conditional outcome function for time period $T = t_2$ with the conditional outcome function for a different time period $T = t_1$ in equation 3, we obtain the following expression:

$$\bar{y}_{t_1,t_2} = \int (y \mid X = x, T = t\_1) \cdot dF(x|T = t_2). \tag{4}$$

We can interpret the term $\bar{y}_{t_1,t_2}$ as counterfactual earnings or employment of denied applicants who applied in period $T = t_2$ if they had applied (and got rejected) in period $T = t_1$. This interpretation is only valid if denied applicants who applied in period t_1 do not differ systematically in unobserved characteristics from denied applicants who applied in period t_2. In the literature, this assumption is known as the *conditional independence assumption* (Fortin, Lemieux, and Firpo, 2011). We think that this assumption is reasonable in the context of our study because we look at changes over short periods of time and because we control for earnings up to 10 years before job loss (aside from other individual characteristics). Because earnings trajectories summarize people's skills and abilities, it is unlikely that people with the same past earnings and other individual characteristics differ systematically in unobserved characteristics.

Using counterfactual earnings or employment, the difference in earnings or employment between and can be decomposed by adding and subtracting the term:

$$\bar{y}_{t_2} - \bar{y}_{t_1} = \Delta\bar{y}\,(x) = (\bar{y}_{t_2} - \bar{y}_{t_1,t_2}) + (\bar{y}_{t_1,t_2} - \bar{y}_{t_1}) \tag{5}$$

Where $\Delta\bar{y}(x)$ is the overall earnings or employment difference and the first difference of the decomposition measures the contribution of changing macroeconomic conditions on the overall earnings or employment difference. The expression is the difference in earnings or employment of denied applicants who applied in period $T = t_2$ and their counterfactual earnings or employment if they had applied in period $T = t_1$ instead (but had the same characteristics). We call this part of the decomposition the business cycle effect and denote it by Δ_{bc}.

The second difference of the decomposition measures the compositional component, denoted by Δ_{comp}. It is the difference in earnings or employment due to changes in applicants' characteristics between the two time periods, evaluated at earnings or employment of the first time period.

In our empirical analysis, we present results for the decomposition as shown in equation 7, using recession years as the second time period and non-recession years as the first time period (whether or not the second time period follows after the first time period). We use earnings or employment five years after application because some applications might still be in process two or three years after they are filed. However, we also calculate decompositions using earnings and employment 2 years after application as a robustness check.

Results

In this section, we first present our main findings for characteristics of applicants and their applications. We then examine how earnings and employment of denied applicants change over the business cycle. We have also conducted various alternative regressions and decompositions as robustness checks (see appendix A). They do not imply any major differences as compared to the main results presented here.

Characteristics of Applicants and Applications

Table 2 displays results for characteristics of all applicants. We also report mean values for each variable to better assess the magnitude of the results.[8] Mean values and level results for populations are expressed in basis points (i.e., number of applications per 10,000 people). The first row shows that a one percentage point increase in the unemployment rate increases applications by 0.5 basis points, which is equivalent to a 3.1 percent increase. This result is similar to those of earlier studies that report magnitudes ranging from 2 to 6 percent (Rupp and Stapleton, 1995).

Interestingly, average age of applicants remains almost unchanged over the business cycle. Similarly, the coefficient for the share of high-school drop-outs is positive but almost equal to zero. The fraction of applicants who also apply for SSI increases during times of high unemployment, indicating that marginal applicants tend to have lower levels of current income and assets as they apply for DI benefits.

Concerning stages of application, the number of applications determined at stages 2, 4, and 5 is positively related to the unemployment rate. By contrast, the number of stage 3

[8] Mean values are weighted averages over all time periods and states for the years 1991 to 2008 and therefore represent average values of the applicant population.

applications remains almost unchanged over the business cycle. Looking at the share of applicants for each application stage, we can see that only the share of applicants rejected at stage 2 or 4 increases with the unemployment rate. In other words, the composition of applicants shifts toward those rejected at stage 2 or 4 (but not toward stage 5) of initial determination during economic downturns.

The shift toward stage 2 and 4 applications suggests that more people with moderate disabilities apply when the unemployment rate is high. Therefore, one would also expect that the fraction of applicants with musculoskeletal impairments or mental disorder increases with the unemployment rate. However, we do not find supportive evidence for such a compositional change. Interestingly, the number of applications with circulatory impairments and neoplasms is also positively related to the unemployment rate.[9] Apparently, these diagnosis groups are heterogeneous and include applicants with serious and less serious disabilities.

Table 3 presents regression results for application duration and outcome. Concerning application outcome, we present results for three measures: initial determination, determination including appeals, and determination including appeals and re-applications within five years. The table first shows mean values, then results for regressions with state-specific fixed effects, and results for regressions that also include applicants' characteristics (excluding determination stages). Both the application duration and the application success rate are negatively related to the unemployment rate. The coefficient for application duration is more negative when other covariates are included, whereas the coefficient for application success is less negative with such covariates included in the regression. Apparently, applicant groups that apply more frequently during economic downturns have on average a longer application processing time and lower application success chance. Still, coefficients for application duration and determination remain negative even after controlling for such compositional changes, suggesting that case workers process claims quicker and tend to be slightly more strict during economic downturns.[10]

Because applications determined at stage 2 and 4 are rejected, it is conceivable that the observed increase in the number of conditional applicants only affects the composition of denied but not accepted applicants. Table 4 presents regression results of applicants' characteristics

[9] The share of applications with circulatory impairments is even positively related to the unemployment rate, whereas the share of applications with neoplasms is negatively related to the unemployment rate.
[10] The estimate of the unemployment rate on application outcome is somewhat smaller as compared to Rupp (2012), who uses a similar regression design, presumably because we also include state-specific time trends.

separately for accepted and denied applicants, using the broadest definition of determination that includes future re-applications within five years. As expected, the number of denied applicants increases much more strongly with the business cycle than the number of accepted applicants. However, the number and share of stage 2 and 4 applications that are ultimately allowed also increases with the unemployment rate. Apparently, these applicants still manage to get into the program, either by appealing the initial rejection, or by re-applying within the next five years. Because coefficients for the level of base points for accepted and denied applicants add up to coefficients for the level of base points for all applicants, we can calculate the percentage of initially rejected applicants at stage 2 and 4 that are accepted in the program after appeals and re-applications using Tables 2 and 4. Specifically, 0.05/0.15=33% of the increase in applications denied at stage 2 are accepted and 0.06/0.14=42% of the increase in applications denied at stage 4 are accepted. Together with stage 5 applications, almost all of the increase in the number of allowances can be attributed to an increase in the number of stage 2, 4, and 5 applications.

The percentage of people who jointly file an application for DI and SSI varies positively with the unemployment rate both for accepted and denied applicants. The magnitude of these coefficients is quite similar, albeit slightly smaller for accepted applicants. For diagnosis groups, we do not see any evidence for compositional changes for either accepted or denied applicants.

The results so far generally support the hypothesis that a higher share of applicants with moderate disabilities apply for DI during recessions. This result is consistent with findings by Coe and Rutledge (2013), who use the *Health and Retirement Study* as well as the *Survey of Income and Program Participation.* Our results also suggests that the changing composition of applicants implies a changing composition of beneficiaries over the business cycle. Moreover, we find that joint DI/SSI applications increase during recessions. This latter result seems puzzling because better health is typically linked to higher income. In the next section, we will investigate earnings and employment vary over the business cycle and how compositional changes versus changes in economic conditions affect average earnings and employment.

Earnings and Employment

AGGREGATE-LEVEL RESULTS. We first estimate panel regressions with earnings or employment of denied applicants from 10 years prior to the year of application through five years after as dependent variables. Appendix Table 2 presents means and regression results and

Figures 2 (for earnings) and 5 (for employment) display coefficients and confidence intervals from this table. Coefficients on unemployment for the level of earnings regressions (Figure 3) are about zero 10 years before application; they quickly become positive and attain their highest magnitude seven to five years before application. Coefficients then get smaller, start being negative two years before application, and remain negative for all subsequent years. Apparently, applicants who apply during times of high unemployment rates tend to have higher earnings several years before claiming DI benefits than those who apply under lower unemployment levels, but lower earnings shortly before and during the years after application. Figure 4 shows results for log of earnings as dependent variables. For most years except for the immediate years after application, coefficient values are modest, ranging between -2 and 2 percent of earnings. Coefficients for the years after application also decrease in magnitude, suggesting that the negative relationship between the unemployment rate and post-application earnings fades out over time.

Figure 5 shows corresponding results for employment. Coefficients exhibit a similar pattern as earnings regressions. The unemployment rate is slightly positively associated with employment several years before application but negatively associated with employment starting 4 to 2 years before application and during the years after application. The negative relationship between the unemployment rate and post-application employment is small, about -1 two years after application (-2 in log terms) and less than -0.5 five years after application (less than -1 in log terms).

DECOMPOSITION. In this section, we present results for the decomposition analysis. We choose two years for the 1990 recession (1991 and 1992) and three years for the 2001 recession (2001 to 2003). The average unemployment rate is 7.2 for the first recession and 5.5 for the second. We compare these recession periods with the intermittent non-recession years, specifically, the years 1996 through 1999, where the unemployment rate was on average 4.8.

Table 5 presents decomposition results for earnings. The first four columns show year and earnings for the recession and non-recession period. The last three columns show the overall earnings difference between recession and non-recession periods (denoted by Δ), the business cycle component (), and the compositional component (). As expected, earnings differences are negative for most years. The average earnings difference between recession and non-recession years is -644 dollars, which is larger than expected from Figure 2.[11] Relative to earnings in recession years, the overall earnings difference is -6 percent. The business cycle component is negative for all years and in most cases larger than the overall difference (on average -1,161 dollars); the compositional component is positive for most cases. The results suggest an important role to employment prospects over the business cycle. Specifically, the business cycle component in itself would reduce earnings by 11 percent relative to earnings of denied applicants who apply during recession years – about twice the overall earnings difference. Compositional changes can only partially offset this strong negative business cycle effect; on average, they halve the earnings difference implied by the business cycle component.

Looking more closely at the different combinations, one can first see that earnings differences are larger in absolute magnitude for the 1990 recession years than for the 2001 recession years (-740 dollars versus -579 dollars), which is consistent with the higher unemployment rate for the earlier recession. A second difference across decompositions is that overall earnings differences as well as business cycle components tend to be larger for earlier non-recession years than for later non-recession years. This suggests that applicants who applied in 1996 and 1997 benefited the most from the strong labor market in subsequent years.

Table 6 presents corresponding results for employment. The average employment difference is small but negative (-0.6 percentage points) and primarily negative for 1996 and 1997 as non-recession years. The business cycle component is on average slightly positive (0.6 percentage points). Apparently, denied applicants who apply during recessions primarily struggle to find better-paying jobs (as opposed to any job) compared to their peers who apply during good economic times.

Discussion and Conclusion

In conclusions, people who apply during recessions appear to be less disabled than people who apply during non-recessions. As a result, they are more likely to be rejected at stage 2 and 4 of initial determination. However, because they can appeal or re-apply, a fraction of these

[11] One possibility is that the relationship between the unemployment rate and earnings is non-linear, which is not captured by the panel regressions. They also include state-specific fixed effects that eliminate some of the variation between the unemployment rate and earnings.

applicants still manages to get into the program, resulting in a positive relationship between the share of new beneficiaries from the stages and the unemployment rate.

We also find a negative relationship between earnings and employment of denied applicants during the years immediately following an application and the unemployment rate. Together with the positive relationship between the unemployment rate and the share of joint DI/SSI applications, these results suggest that applicants who apply during recessions suffer from income and asset losses around the time of application because of economic conditions. Finally, our decomposition results indicate that changes in the composition of applicants by itself would result in a positive relationship between the unemployment rate and post-application earnings and employment. However, the business cycle effect is negative and dominates the compositional effect, resulting in an overall negative relationship between earnings or employment and the unemployment rate.

These findings support and expand on the concept put forth by Autor and Duggan (2003). Our results show that essentially all of the increase in applications and allowances during recessions can be attributed to an increase in applications of conditional applicants, whose application is determined at stage 2, 4, or 5. However, we do not find a positive relationship between earnings of denied applicants several years after application and the unemployment rate; to the contrary, average earnings and employment of denied applicants appears to be negatively related to the unemployment rate. This suggests that Autor and Duggan's framework needs to be extended to incorporate how economic conditions affect job prospects of applicants. If, as our decomposition results suggests, the very reason conditional applications rise during recessions – losing a job – is related to lower job prospects during such times, then a rise in conditional applications during economic downturns does not necessarily imply an increase in average earnings and employment of denied applicants post application.

This study also complements the findings reported by von Wachter, Song, and Manchester (2011) for long-term changes in the composition and work capacity of applicants. By contrast, we find no evidence that younger workers apply more frequently during recessions and that the work capacity of applications during economic downturns is higher. These differences highlight that changes to the economic versus policy environment have distinct effects on the disability program. Specifically, von Wachter, Song, and Manchester (2011) examine compositional changes following policy reforms of the program making the program more accessible to people with difficult to determine health impairments. For our study, the policy environment remains relatively stable, and most of the compositional changes occur due to short-term changes in the economic environment.

Our results also have important policy implications. They highlight that the employment prospects of applicants are not just a function of their individual characteristics but also of the macroeconomic environment. This is why less disabled applicants who apply during economic downturns and who are denied may not have higher post-application earnings and employment. The disability program is not well suited to respond to these short-term changes in economic conditions and the resulting changes in the composition of applicants. Specifically, our results show that many of the additional applications during recessions are quickly rejected, only to end up on the program after the appeals process.

Instead of going through the lengthy appeals process that might further diminish their chances of finding new employment, it would be much more beneficial to provide short-term financial support together with re-employment services to them. As recent research suggests, providing temporary assistance to people out of work can dissuade some of them from applying for DI benefits, at least in the short term (Lindner, 2011; Lindner and Nichols, 2012; Rutledge, 2011). However, the negative business cycle effect also highlights that people who apply during recessions face severe barriers to employment even if they are on average less disabled than people who apply during non-recession periods. Providing adequate training and other services to reintegrate these people into the labor market instead of letting them into the DI program is therefore a challenging endeavor.

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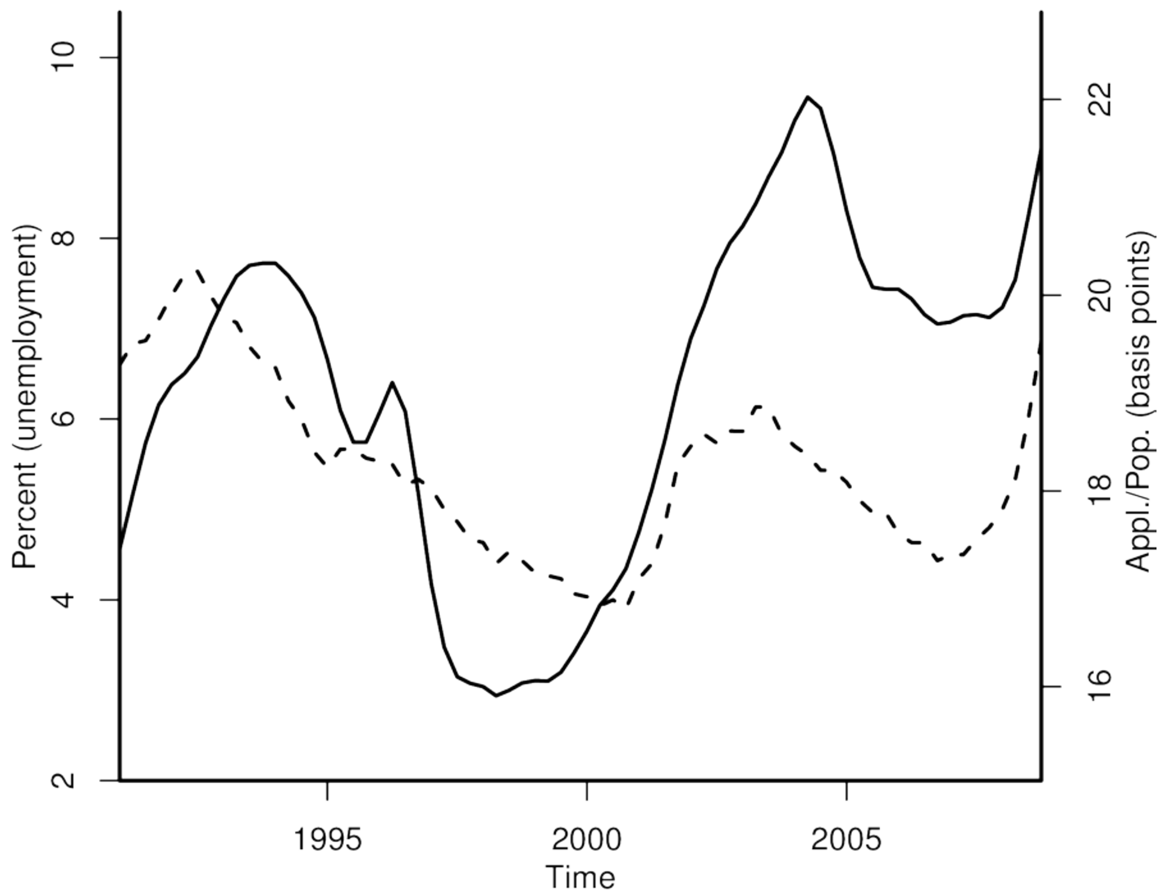
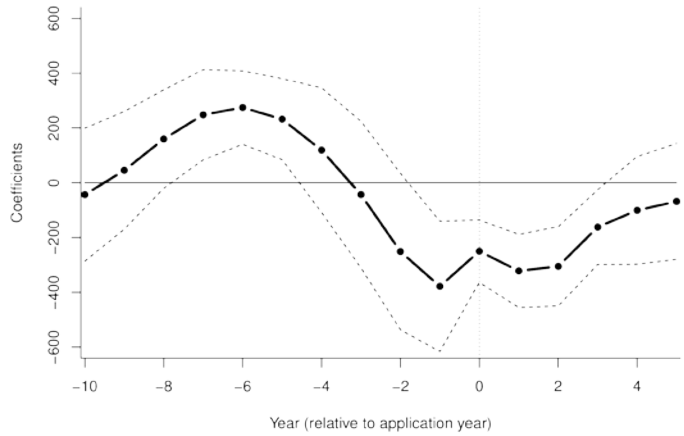
Figure 1. *Number of Applications for DI and the Unemployment Rate, 1991-2008*



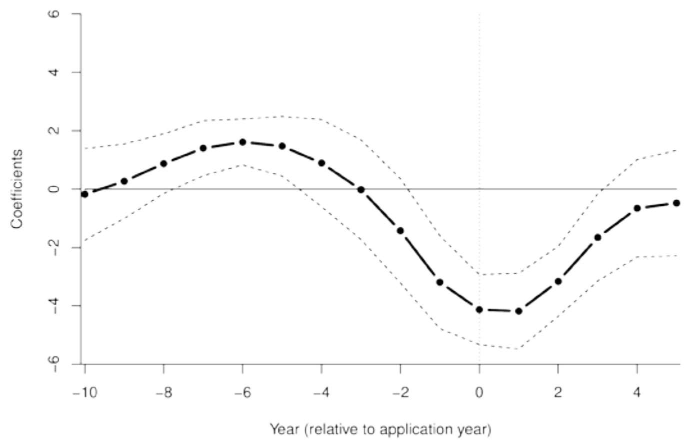
Notes:
This figure shows trends in the unemployment rate and applications per population for DI. The unemployment rate (striped line) is expressed in percentage points as shown by the left y-axis. Applications per population for DI (solid line) are expressed as one hundredth of a percentage point, or one part per 10 thousand (basis points) as shown by the right y-axis. Population is the number of people age 20 to 64. Both trends are by calendar quarters and seasonally adjusted.

Figure 2. *Regression Results for Earnings of Denied Applicants and the Unemployment Rate*

(a): Level of earnings



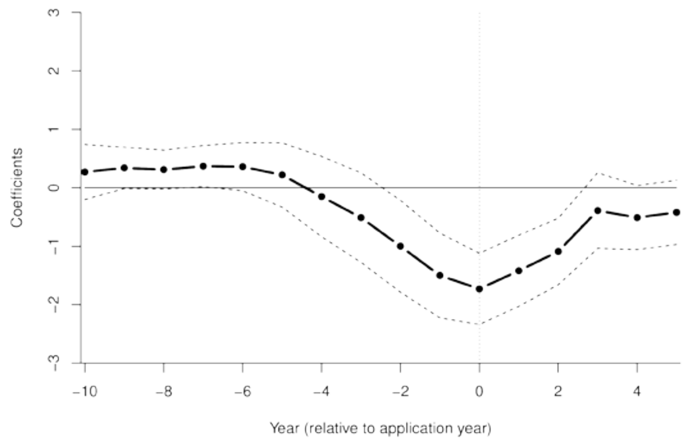
(b): Log of earnings



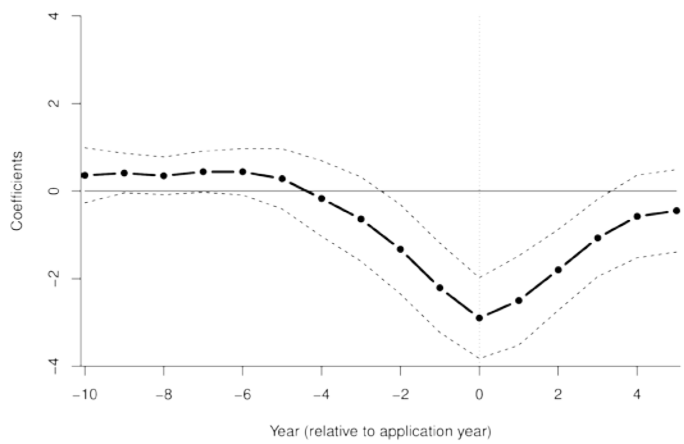
Notes: These figures display the relationship between the unemployment rate and past and future earnings of denied applicants. Each point represents results from a separate regression with earnings during year *X* relative to the application year as dependent variable, where *X* is the number on the x-axis, ranging from 10 years before to 5 years after the year of application. Regressions include the unemployment rate as well as state fixed-effects, year fixed effects, and state fixed effects interacted with linear time trends. Points show estimates for the unemployment rate. Figure 2 shows results for level or earnings and Figure 2 shows results for log of earnings. Striped lines indicate 95 percent confidence intervals. All standard errors are clustered at the state level.

Figure 3. *Regression Results for Employment of Denied Applicants and the Unemployment Rate*

(a): Level of employment



(b): Log of employment



Notes: These figures display the relationship between the unemployment rate and past and future employment of denied applicants. Each point represents results from a separate regression with employment during year *X* relative to the application year as dependent variable, where *X* is the number on the x-axis, ranging from 10 years before to 5 years after the year of application. Regressions include the unemployment rate as well as state fixed-effects, year fixed effects, and state fixed effects interacted with linear time trends. Points show estimates for the unemployment rate. Figure 3 shows results for level or employment and Figure 3 shows results for log of employment. Striped lines indicate 95 percent confidence intervals. All standard errors are clustered at the state level.

Table 1. *Hypotheses for the Association of Applicant Characteristics and the Unemployment Rate*

Characteristic	Average / share of applicants	Number of applications
Age	-	
Applicants without HS degree	+/-	+/0
Application for DI/SSI	+/-	+/0
Stage 2 applicants	+	+
Stage 3 applicants	-	0
Stage 4 applicants	+	+
Stage 5 applicants	+	+
Musculoskeletal impairment	+	+
Mental disorder	+	+
Circulatory impairment	-	0
Neoplasms	-	0
Earnings/employment before application	+	
Earnings/employment during / after application	+/-	
Application duration	+/-	
Accepted at initial determination	+/-	
Accepted at final determination	+/-	

Notes: This table shows hypotheses for the relationship between characteristics of applicants and the unemployment rate. A positive sign stands for a positive relationship, a negative sign for a negative relationship, and a zero for no relationship between the unemployment rate and the variable. The second column shows signs for the average or share of applicants. The third column shows signs for the number of applications.

Table 2. *Regression Results for Applicant Characteristics and the Unemployment Rate*

Variable	Mean	Level	Log
Applications (b.p.)	19.8	0.53***	3.10***
		(0.09)	(0.38)
Age (years, mean)	45.5	-0.04	-0.08
		(0.02)	(0.05)
Appl. without HS (%)	29.5	0.04	0.06
		(0.08)	(0.32)
Appl. without HS (b.p.)	5.9	0.13***	3.16***
		(0.04)	(0.54)
Appl. for DI/SSI (%)	51.3	0.81***	1.85***
		(0.13)	(0.34)
Appl. for DI/SSI (b.p.)	10.3	0.40***	4.95***
		(0.06)	(0.56)
Stage 2 applicants (%)	14.9	0.59**	4.13***
		(0.19)	(1.04)
Stage 2 applicants (b.p.)	3.0	0.15***	7.22***
		(0.05)	(1.24)
Stage 3 applicants (%)	21.9	-0.47**	-2.17**
		(0.15)	(0.73)
Stage 3 applicants (b.p.)	4.2	0.05	0.93
		(0.03)	(0.64)
Stage 4 applicants (%)	17.5	0.35	2.68*
		(0.20)	(1.20)
Stage 4 applicants (b.p.)	3.5	0.14**	5.78***
		(0.04)	(1.33)
Stage 5 applicants (%)	37.1	-0.35	-1.21
		(0.26)	(0.68)
Stage 5 applicants (b.p.)	7.4	0.18**	1.90**
		(0.07)	(0.72)
Appl. with musculoskeletal imp. (%)	27.8	-0.05	-0.07
		(0.13)	(0.47)
Appl. with musculoskeletal imp. (b.p.)	5.5	0.15***	3.03***
		(0.03)	(0.54)
Appl. with mental disorders (%)	20.9	-0.04	-0.19
		(0.10)	(0.45)
Appl. with mental disorders (b.p.)	4.1	0.11**	2.91***
		(0.04)	(0.67)
Appl. with circulatory imp. (%)	10.4	0.02	0.04
		(0.03)	(0.28)
Appl. with circulatory imp. (b.p.)	2.1	0.05***	3.14***
		(0.01)	(0.40)

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Table 2. *Regression Results for Applicant Characteristics and the Unemployment Rate* (cont'd)

Variable	Mean	Level	Log
Appl. with neoplasms (%)	7.0	-0.11***	-1.42***
		(0.02)	(0.30)
Appl. with neoplasms (b.p.)	1.4	0.02***	1.68***
		(0.00)	(0.30)

Notes: Each cell of the third and fourth column represents a separate regression and displays the coefficient for the unemployment rate in a regression with the dependent variable as given by the first column. All regressions use the number of applications of a state per period as weights and include state fixed effects, year fixed effects, and state fixed effects interacted with linear time trends. Age is expressed in years. All other variables are either expressed as percentage of all applicants or as basis points (number of applicants with that characteristic per 10 thousand adults for a time period and state). Standard errors are clustered at the state level and displayed in parentheses below corresponding coefficients. Mean values refer to weighted averages over all states and the time period 1991 to 2008. The sample size for all regressions is 3744. * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

Table 3. *Regression Results for Application Outcomes and the Unemployment Rate*

Variable	Mean	State-specific FE	Applicants' characteristics
		Level	
Application duration (days)	162.3	-2.24	-3.49**
		(1.61)	(1.33)
Accepted at initial determination (%)	40.6	-1.40***	-0.52*
		(0.36)	(0.23)
Accepted at final determination (%)	57.5	-0.84***	-0.37**
		(0.22)	(0.14)
Accepted including future determinations (%)	65.5	-0.77***	-0.38**
		(0.18)	(0.12)
		Log	
Application duration (days)	162.3	-1.08	-1.95*
		(0.87)	(0.77)

Notes: Each cell of the third and fourth column represents a separate regression and displays the coefficient for the unemployment rate in a regression with the dependent variable as given by the first column. All regressions use the number of applications of a state per period as weights. Regressions with state-specific fixed effects (third column) include state fixed effects, year fixed effects, and state fixed effects interacted with linear time trends. Regressions with applicants characteristics (fourth column) include these fixed effects and also the following covariates: number of applicants in basis points; average age of applicants, fraction of male applicants, fraction of applicants classified as white, fraction of applicants with a high-school degree and with some college experience (base category: fraction of applicants with no high-school degree), fraction of applicants who apply for DI only, fraction of applicants whose initial application is determined at stage 3, 4, and 5 (base category: stage 2), and the fraction of applicants in one of the diagnosis code groups (base category:). Mean values refer to weighted averages for the time period 1991 to 2008. Standard errors are clustered at the state level and displayed in parentheses below corresponding coefficients. The sample size for all regressions is 3744.
* $p<0.05$, ** $p<0.01$, *** $p<0.001$.

Table 4. *Regression Results for Characteristics of Accepted and Denied Applicants and the Unemployment Rate*

	Accepted		Denied	
Variable	Level	Log	Level	Log
Applications (b.p.)	0.23***	1.92***	0.31***	5.22***
	(0.06)	(0.39)	(0.05)	(0.67)
Age (years, mean)	-0.02	-0.04	0.06	0.15
	(0.02)	(0.04)	(0.05)	(0.13)
Appl. without HS (%)	-0.01	-0.23	0.03	0.14
	(0.08)	(0.31)	(0.10)	(0.37)
Appl. without HS (b.p.)	0.05*	1.69**	0.08***	5.35***
	(0.02)	(0.60)	(0.02)	(0.75)
Appl. for DI/SSI (%)	0.59***	1.57***	0.78***	1.44***
	(0.12)	(0.36)	(0.17)	(0.32)
Appl. for DI/SSI (b.p.)	0.17***	3.49***	0.23***	6.67***
	(0.03)	(0.57)	(0.04)	(0.80)
Stage 2 applicants (%)	0.36**	5.96***	0.58*	1.66*
	(0.13)	(1.77)	(0.28)	(0.65)
Stage 2 applicants (b.p.)	0.05**	7.88***	0.11***	6.87***
	(0.02)	(1.70)	(0.03)	(1.09)
Stage 4 applicants (%)	0.39*	4.32**	-0.11	-0.02
	(0.19)	(1.47)	(0.28)	(1.23)
Stage 4 applicants (b.p.)	0.06*	6.24***	0.08***	5.20***
	(0.03)	(1.43)	(0.02)	(1.26)
Stage 5 applicants (%)	-0.38	-1.11	0.00	-0.21
	(0.28)	(0.65)	(0.24)	(0.79)
Stage 5 applicants (b.p.)	0.08	0.82	0.11***	5.01***
	(0.05)	(0.86)	(0.02)	(0.84)
Appl. with musculoskeletal imp. (%)	-0.00	0.00	-0.27	-0.62
	(0.10)	(0.40)	(0.24)	(0.78)
Appl. with musculoskeletal imp. (b.p.)	0.07***	1.92**	0.09***	4.59***
	(0.02)	(0.59)	(0.01)	(0.78)
Appl. with mental disorders (%)	-0.11	-0.72	0.18	1.33
	(0.14)	(0.56)	(0.15)	(0.83)
Appl. with mental disorders (b.p.)	0.04	1.21	0.07***	6.55***
	(0.03)	(0.81)	(0.02)	(1.25)
Appl. with circulatory imp. (%)	0.05	0.39	0.06	0.54
	(0.04)	(0.32)	(0.04)	(0.52)
Appl. with circulatory imp. (b.p.)	0.03***	2.31***	0.02***	5.76***
	(0.01)	(0.43)	(0.00)	(0.97)

-continued-

Table 4. *Regression Results for Characteristics of Accepted and Denied Applicants and the Unemployment Rate* (cont'd)

	Accepted		Denied	
Variable	Level	Log	Level	Log
Appl. with neoplasms (%)	-0.06	-0.55	-0.02	-1.03
	(0.04)	(0.37)	(0.02)	(0.94)
Appl. with neoplasms (b.p.)	0.02***	1.38***	0.01***	4.19***
	(0.00)	(0.23)	(0.00)	(1.21)

Notes: Each cell of the third and fourth column represents a separate regression and displays the coefficient for the unemployment rate in a regression with the dependent variable as given by the first column. All regressions use the number of applications of a state per period as weights and include state fixed effects, year fixed effects, and state fixed effects interacted with linear time trends. Age is expressed in years. All other variables are either expressed as percentage of all applicants or as basis points (number of applicants with that characteristic per 10 thousand adults for a time period and state). Standard errors are clustered at the state level and displayed in parentheses below corresponding coefficients. Mean values refer to weighted averages over all states and the time period 1991 to 2008. The sample size for all regressions is 3744. * p<0.05, ** p<0.01, *** p<0.001.

Table 5. *Decomposition Results for Earnings*

Recession		Non-recession		Decomposition		
Year	Earnings	Year	Earnings	Δ	Δ_{bc}	Δ_{comp}
1991	9974	1996	11664	-1690	-2148	459
1992	10494	1996	11664	-1170	-1466	296
2001	10579	1996	11664	-1085	-976	-109
2002	10553	1996	11664	-1111	-1258	146
2003	10054	1996	11664	-1610	-2138	529
1991	9974	1997	11092	-1118	-1835	717
1992	10494	1997	11092	-598	-1156	557
2001	10579	1997	11092	-513	-492	-21
2002	10553	1997	11092	-540	-764	224
2003	10054	1997	11092	-1038	-1645	607
1991	9974	1998	10552	-578	-1513	936
1992	10494	1998	10552	-58	-877	819
2001	10579	1998	10552	27	21	6
2002	10553	1998	10552	1	-302	302
2003	10054	1998	10552	-498	-1268	770
1991	9974	1999	10590	-616	-1869	1253
1992	10494	1999	10590	-96	-1416	1320
2001	10579	1999	10590	-11	-160	149
2002	10553	1999	10590	-37	-489	452
2003	10054	1999	10590	-536	-1478	943

Notes: The table shows average earnings of denied applicants for years pertaining to recession and non-recession years as well as decomposition results. Δ is the overall mean earnings difference between mean earnings during a recession years and mean earnings during a non-recession years. is the estimated business-cycle part of the overall difference and the compositional part of the overall difference. See text for details of the decomposition and these terms. All earnings are expressed in January, 2010 values.

Table 6. *Decomposition Results for Employment*

Recession		Non-recession		Decomposition		
Year	Employment	Year	Employment	Δ	Δ_{bc}	Δ_{comp}
1991	50.8	1996	55.9	-5.1	-7.4	2.3
1992	53.6	1996	55.9	-2.3	-3.5	1.2
2001	52.7	1996	55.9	-3.3	-1.5	-1.8
2002	52.9	1996	55.9	-3.0	-2.0	-1.0
2003	51.2	1996	55.9	-4.8	-5.0	0.2
1991	50.8	1997	53.2	-2.4	-4.8	2.4
1992	53.6	1997	53.2	0.5	-1.0	1.4
2001	52.7	1997	53.2	-0.5	1.0	-1.5
2002	52.9	1997	53.2	-0.2	0.4	-0.7
2003	51.2	1997	53.2	-2.0	-2.6	0.6
1991	50.8	1998	51.1	-0.3	-2.8	2.5
1992	53.6	1998	51.1	2.5	0.9	1.6
2001	52.7	1998	51.1	1.5	3.0	-1.5
2002	52.9	1998	51.1	1.8	2.5	-0.7
2003	51.2	1998	51.1	0.0	-0.6	0.7
1991	50.8	1999	51.0	-0.2	-3.3	3.1
1992	53.6	1999	51.0	2.6	0.4	2.2
2001	52.7	1999	51.0	1.7	2.5	-0.8
2002	52.9	1999	51.0	1.9	1.9	-0.0
2003	51.2	1999	51.0	0.2	-1.1	1.3

Notes: The table shows average employment in percent of denied applicants for years pertaining to recession and non-recession years as well as decomposition results. Δ is the overall mean employment difference between mean employment during a recession years and mean employment during a non-recession years. is the estimated business-cycle part of the overall difference and the compositional part of the overall difference. See text for details of the decomposition and these terms.

Robustness Checks

Including Years of the Great Recession

We repeat regressions for applicants' characteristics with the years 2009 and 2010 included in our panel. We exclude these years for our main analysis because post-application earnings are not observed and an increasing fraction of applications filed during these years are still pending. Still, including these years allows us to assess whether results for characteristics of applicants are robust to including years characterized by a much higher unemployment rate and application numbers. In general, most results from our main analysis change little. The coefficient for stage 4 applications is a bit smaller as compared to Table 2 and the coefficient for stage 5 applications is still negative.

Unweighted Regressions

We also estimate our regressions using no weights and find very similar results. The coefficient for high-school drop-outs is slightly larger in this specification and so is the coefficient for joint DI/SSI applications. We also find a somewhat larger relationship between the unemployment rate and the share or applicants with applications determined at stage 4. However, we find no substantial differences for the large groups of marginal applicants, namely those with applications determined at stage 5 and those with a musculoskeletal impairments or mental disorder. Overall, these results suggest that the relationship between short-term fluctuations of the unemployment rate and characteristics of applicants are similar across states.

Applicants with Stage 5 Determination

We look at characteristics of applicants with applications determined at the fifth stage of initial determination to examine whether the composition of this group of applicants changes over the business cycle despite no apparent increase in the share of applicants from this group. Interestingly, we find a much stronger negative relationship between the unemployment rate and age for this group of applicants as compared to all applicants. We also speculate that because applications for this group is determined by vocational factors and the judgment of case workers, application decisions might vary more for them as for other groups of applicants. However, regression results reveal essentially no relationship between the application outcome (both initial and final) and the unemployment rate for these applicants.

Distributed Lag Models

Because many applicants for DI do not immediately file an application after losing their job (Lindner, 2013), it is plausible that lagged values of the unemployment rate are also associated with applicants' characteristics and outcomes. We estimate models with four quarters of lags (one year for regressions with years as frequency) of the unemployment rate. Results for these distributed lag models are very similar to results from our main specification without lags. In most cases, the sum of the lagged coefficients is a bit larger than the coefficient from the OLS regression. Coefficients for stage 5 determinations and musculoskeletal impairments remain essentially unchanged.

Decomposing Earnings and Employment Two Years after Application

We carry out decompositions for earnings and employment of denied applicants 2 years after application. Consistent with Figures 2 and 5, the overall earnings and employment difference is somewhat larger two years after application. Most of the larger difference appears as the business cycle component, suggesting that denied applicants initially find it harder to find valuable employment during recessions, but that the business cycle effect attenuates over subsequent years. This results may also reflect that some applications are not fully determined 2 years after application begin.

Appendix Tables

Appendix Table 1. *Comparison of Earnings and Employment of Denied Applicants to von Wachter, Song, and Manchester (2011)*

	von Wachter et al. (2011)	Our sample
Rejected male 1997 applicants age 45-64, 2 years after application		
Percent positive earnings	52.6	45.9
Median positive annual earnings	10,000	11,144
Rejected male 1997 applicants age 30-44, 2 years after application		
Percent positive earnings	69.6	67.1
Median positive annual earnings	8,000	11,325

Notes: All monetary values are expressed in 1997 dollars. Results from von Wachter, Song, and Manchester (2011) are from Table 1, year 1997, rejected applicants.

Appendix Table 2. *Regression Results for Earnings and Employment*

Year relative	Earnings			Employment		
to appl. year	Mean	Level	Log	Mean	Level	Log
s	14921	-43.52	-0.18	75.9	0.27	0.36
		(123.66)	(0.80)		(0.24)	(0.32)
-9	15284	45.39	0.27	77.9	0.34	0.41
		(109.48)	(0.65)		(0.18)	(0.23)
-8	15623	159.56	0.87	79.7	0.31	0.35
		(91.65)	(0.52)		(0.17)	(0.22)
-7	15834	248.11**	1.40**	81.1	0.37*	0.44
		(83.84)	(0.48)		(0.18)	(0.24)
-6	15833	274.66***	1.61***	81.7	0.36	0.44
		(68.33)	(0.40)		(0.21)	(0.27)
-5	15648	232.20**	1.47**	81.5	0.22	0.28
		(75.33)	(0.52)		(0.28)	(0.35)
-4	15280	119.19	0.89	80.5	-0.15	-0.17
		(115.96)	(0.76)		(0.35)	(0.44)
-3	14632	-43.23	-0.02	78.6	-0.51	-0.64
		(136.29)	(0.87)		(0.39)	(0.49)
-2	13363	-250.92	-1.43	75.1	-1.00*	-1.33*
		(145.45)	(0.91)		(0.40)	(0.52)
-1	10453	-378.11**	-3.19***	68.8	-1.50***	-2.21***
		(121.23)	(0.81)		(0.37)	(0.52)
0	5317	-249.86***	-4.13***	58.3	-1.73***	-2.90***
		(57.89)	(0.61)		(0.31)	(0.47)
1	6440	-321.80***	-4.18***	53.6	-1.42***	-2.50***
		(68.18)	(0.66)		(0.31)	(0.52)
2	8137	-305.05***	-3.16***	55.3	-1.09***	-1.80***
		(73.67)	(0.61)		(0.29)	(0.47)
3	8614	-161.83*	-1.66*	53.3	-0.39	-1.07*
		(69.47)	(0.76)		(0.33)	(0.45)
4	9783	-100.54	-0.66	56.7	-0.51	-0.58
		(100.07)	(0.85)		(0.28)	(0.48)
5	10222	-68.13	-0.48	56.5	-0.42	-0.45
		(107.81)	(0.92)		(0.28)	(0.48)

Notes: Each cell of the third, fourth, seventh and eighth column represents a separate regression and displays the coefficient for the unemployment rate with the dependent variable being earnings or employment during a year *X* relative to the application year as dependent variable, where *X* is the number shown by the first column. Earnings are expressed in 2010 dollars. All regressions use the number of applications of a state per period as weights and include state fixed effects, year fixed effects, and state fixed effects interacted with linear time trends. Standard errors are clustered at the state level and displayed in parentheses below corresponding coefficients. Mean values refer to weighted averages over all states and the time period 1991 to 2008. The sample size for all regressions is 936. * p<0.05, ** p<0.01, *** p<0.001.

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