# Does Delay Cause Decay? The Effect of Administrative Decision Time on the Labor Force Participation and Earnings of Disability Applicants*


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**Abstract**

An influential body of research studies the labor supply and earnings of denied Social Security Disability Insurance (SSDI) applicants to estimate the potential employment and earnings of those awarded benefits. This research design implicitly treats employability as a stable applicant attribute that is not directly impacted by the process of applying for SSDI benefits. If, plausibly, applicants' employment potential deteriorates while they are out of the labor force, then the labor force participation of denied applicants—who spend an average of 10 months seeking benefits—may understate their employment potential at the time of application. This paper tests whether the duration of SSDI applications causally affects applicants' subsequent employment. We use a unique Social Security Administration workload database to identify exogenous variation in applicants' initial decision times induced by differences in processing speed among the disability examiners to which they are randomly assigned. This variation significantly affects applicants' total processing time but, importantly, is uncorrelated with their initial award and denial outcomes. We find that longer processing times reduce the employment and earnings of SSDI applicants in the years after their initial decision. A one standard deviation (2.4 month) increase in initial processing time reduces annual employment rates by 1 percentage point (3.2%) in years two, three and four post-decision. Extrapolating these effects to total applicant processing times, we estimate that the SSDI determination process directly reduces the post-application employment of denied applicants by approximately 4.1 percentage points (8%) and allowed applicants by approximately 5.5 percentage points (38%).



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# Introduction

An influential body of research analyzes the causal effect of receipt of Social Security Disability Insurance benefits (SSDI) on employment and earnings by comparing the post-application labor force participation of those awarded benefits relative to those denied benefits.[1] Implicit in this analytic approach is the assumption that the SSDI determination process affects applicants' labor supply exclusively through a single causal channel—the allowance or denial decision. While this channel is undoubtedly of first-order importance, the SSDI determination process may affect labor supply through other channels as well. One such channel is inducement: unemployed workers and those with weak labor force attachment may potentially exit the labor force to apply for SSDI rather than seeking employment (Parsons 1980, Black, Daniel and Sanders 2002, Autor and Duggan 2003). A second channel, and the focus of this paper, is that the SSDI disability determination process may directly reduce applicants' subsequent employment and earnings potential by prolonging their time out of the labor force. If, as hypothesized by Parsons (1991), applicants' employment potential decays while they are non-participants in the the labor force, then the observed post-application labor supply of denied and allowed applicants may understate their employment potential at the time of SSDI application. Moreover, if either the rate of deterioration or average SSDI processing time differs between allowed and denied applicants, a comparison of their post-SSDI determination labor supply may not identify the pure effect of the SSDI award on employment outcomes.

From the time that an SSDI application is filed to the time a final determination is made, the applicant may not earn more than $1,000 per month in paid employment, since this would exceed the Substantial Gainful Activity (SGA) threshold and result in a denial of benefits. The SSDI application process is typically lengthy, with several levels of determination and appeal. In our administrative sample of SSDI applicants, discussed below, the average time from SSDI application to final determination exceeds one year (14.2 months). Nearly half (46 percent) of SSDI applicants—including those who are ultimately allowed as well as denied—challenge their initial determination and face processing times on average exceeding two years (26.5 months). Notably, because half of beneficiaries are allowed only after a lengthy appeal, those who are ultimately awarded benefits experience longer processing times on average than those who are ultimately denied (15.4 versus 11.6 months). Hence, both for those ultimately awarded and denied benefits, it is plausible that the substantial time spent out of the labor force while applying for benefits may have deleterious effects on skills, job readiness and employability. Due to the scale of the SSDI program, even modest deleterious effects of the SSDI application process on the subsequent labor force participation of applicants could have economically significant implications. More than 24 million Americans applied for SSDI benefits in the past ten years, with nearly 3 million applications filed in 2010 alone at the

[1] Bound (1989) introduced the empirical approach of using the labor supply of denied SSDI applicants to form an upper bound on the potential labor supply of accepted applicants, an approach recently employed by von Wachter, Song, and Manchester (2011). Bound (1991) and Parsons (1991) debate the validity of this comparison. Several recent papers in this literature, including Chen and van der Klaauw (2005), Maestas, Mullen and Strand (2013), and French and Song (forthcoming) exploit plausibly exogenous variation in SSDI awards to estimate the causal effect of receiving SSDI benefits on labor supply.

height of the Great Recession.[2]

This paper presents the first causal evidence that longer SSDI application processing times decrease post-decision employment rates among SSDI applicants. We use a unique Social Security Administration (SSA) workload database containing the universe of SSDI applications in 2005 to identify exogenous variation in applicants' initial decision times induced by differences in processing speed among the disability examiners to which they are randomly assigned. The average examiner in our sample spends around 3 months reviewing a case prior to making an initial determination. Mean determination times differ significantly across examiners, however, with the 90/10 range in mean examiner time equal to 2.2 months. Notably, the characteristics of applicants assigned to each examiner and geographic variation in processing times explain less than a third of cross-examiner variation. The remaining variation is likely primarily attributable to productivity differentials among SSA employees.

Critical to our identification strategy, we show that this examiner-level variation in average processing times significantly affects applicants' total processing time but is uncorrelated with initial allowance decisions. In combination with the random assignment of applicants to examiners within a Disability Determination Service (DDS) office, these findings validate our use of examiner-specific mean processing times as an instrumental variable for the realized processing times of the cases to which they are assigned and determine to be disabled. That is, we test whether the duration of the initial level of the SSDI determination process affects the subsequent employment of applicants who were awarded benefits at the DDS level. The SSDI program allows new beneficiaries to "test" their ability to work by engaging in SGA without penalty during a combined (not necessarily consecutive) 12-month Trial Work Period (TWP) and Grace Period, which commence after a 5-month Waiting Period during which beneficiaries must refrain from working.[3] Benefit payments also commence at the end of the Waiting Period. Beneficiaries notified after the Waiting Period has elapsed may receive up to 19 months of back-dated benefits, but importantly they cannot go back in time to re-enter the labor market.

Exploiting examiner-level variation, we find that longer processing times significantly reduce the employment and earnings of *initially allowed* SSDI applicants in the years after their determination. Our main estimates indicate that a one-month increase in processing time reduces annual post-decision employment rates by 0.3 to 0.4 percentage points or 7.5 to 10 percent. This effect remains robustly significant into the sixth post-determination year, 2011 (the final year we observe). Importantly, the effect of additional processing time is concentrated entirely in the period beginning 5 months after the date of onset, defined by SSA as the date when the health impairment began to interfere with work or the date the individual stopped working, whichever is later. This is important because the TWP does not commence until beneficiaries have completed the 5-month Waiting Period, during which they must not perform SGA. Thus, beneficiaries notified during the Waiting

[2] Statistics available at http://www.ssa.gov/OACT/STATS/dibStat.html, accessed 6/3/2013.

[3] Beneficiaries exhausting the TWP and Grace Period then enter a 3-year Extended Period of Eligibility (EPE) during which benefits are paid for months in which earnings are below SGA and not paid when earnings are above SGA. After the EPE, beneficiaries may no longer engage in SGA or their benefits will be suspended permanently; however, they are then eligible for Expedited Reinstatement (EXR) if they become unable to engage in SGA.

Period must continue to refrain from employment until they reach the end of 5 months; beneficiaries notified after the Waiting Period may immediately re-enter the labor market if they wish.[4] We find that additional processing time does not have a statistically significant effect on subsequent employment among beneficiaries notified of their award during the Waiting Period; however, each additional month of processing time after the Waiting Period has elapsed reduces subsequent employment by 0.4 percentage points or 10 percent.

We next broaden the sample to include both initially allowed and initially denied SSDI applicants. The inclusion of initially denied applicants presents an additional challenge because, as our data reveal, delays in the initial disability determination process raise the likelihood that denied applicants subsequently appeal their initial determinations and ultimately receive awards—plausibly because longer processing times spur greater skills deterioration, thereby lowering the opportunity costs of further appeals. Accordingly, identification of the causal effect of processing time on initially denied applicants requires an additional source of variation that affects the likelihood of receiving an SSDI allowance but is uncorrelated with either applicants' health or their initial processing times. Following Maestas, Mullen and Strand (2013, MMS hereafter), we use variation in examiner allowance propensity as this second source of variation. The random assignment of applicants to disability examiners with different allowance propensities generates exogenous variation in decision outcomes that is unrelated to unobserved impairment severity or labor force attachment.[5]

Exploiting both sources of variation, we find that longer processing times significantly reduce the employment and earnings of both initially allowed and initially denied SSDI applicants in the years following determination. Denied applicants in our sample spend approximately one full year (11.6 months) applying for SSDI benefits. Our main estimates imply that this reduces their probability of subsequent employment by more than four percentage points two years after initial application, and by approximately three percentage points in years four and six following application. Given that less than half of denied applicants participate in the labor force, these effects are sizable. We infer that the requirement that SSDI applicants refrain from engaging in SGA while awaiting a decision imposes real, long term costs in the form of lost human capital—both among those denied and those allowed benefits.

The existence of an employment decay effect as a distinct causal channel through which the SSDI determination process affects post-application labor supply outcomes—separate from the benefit receipt effect, which has been the sole focus of the literature to date—has important implications for the total impact of the SSDI program on available and unrealized work capacity. Figure 1 presents a simple schematic illustration (with a formal model to follow) to motivate the potential importance of the human capital decay effect and its relationship to the widely studied benefit receipt effect. The

[4]Because beneficiaries notified after the Waiting Period receive back payments (without interest) for the missed benefits, there is little difference in the present discounted value of the benefit stream for applicants notified before or after the Waiting Period.

[5]Interestingly, we find that examiner allowance propensity is essentially uncorrelated with examiner processing time. Thus, random assignment of examiners generates independent variation in two distinct elements of the disability application process: the likelihood of receiving an initial allowance and the expected processing time for an initial decision.

figure shows observed earnings of SSDI applicants as a function of time since the SSDI application for an applicant in two potential states of the world: allowed (green) and denied (red). In this figure, the vertical distance $\gamma$ represents the causal effect of an SSDI allowance on earnings (or alternatively, the probability of labor force participation). The slopes of the red and green lines, $-\delta$, reflect the causal effect of time out of the labor force on earnings (or employment): both allowed and denied applicants lose work capacity at rate $\delta$ with elapsed time out of the labor force. Thus, the earnings or labor force participation of denied SSDI applicants understate their labor force potential at the time of application, with the gap between initial and final work capacity growing with the length of application.

One empirical implication of this simple framework is that the observed post-determination labor supply of both allowed and denied SSDI applicants will understate their latent work capacity at the time of application—since work capacity following the disability determination process will have decayed relative to work capacity at the time of the initial application. A second implication is that OLS and 2SLS estimates that compare the post-application labor supply of allowed and denied applicants will generally produce biased estimates of the direct effect of the disability allowance on labor supply if these comparisons do not account for systematic differences in processing time between allowed and denied applicants.[6] Our instrumental variables strategy overcomes this confound by instrumenting for both processing time and the probability of SSDI allowance. Our estimates indicate that the bias that arises from ignoring the effect of the decay channel on labor supply is substantial. Instrumental variables estimates of the effect of SSDI award on labor supply that do not account for the decay channel imply that the disability award reduces labor force participation by 33 percentage points two years following application, and 20 percentage points six years following application, for those on the margin of program entry. Accounting for the delay-decay channel raises this estimate to 48 percentage points in year two post-application, and 30 percentage points in year six. Thus, a research design that does not fully account for the effect of processing delays on labor supply will understate the causal effect of SSDI award on latent work potential (i.e., at the time of application) by approximately 50 percent.

Our findings have important implications for the potential success of reform efforts aimed at returning current SSDI beneficiaries to the labor force, such as the widely discussed benefit offset proposal that would eliminate the "cash cliff" whereby benefits are suspended for those earning at or above the SGA threshold—but would keep in place the SGA threshold's role in determining eligibility for benefits. If the work capacity of beneficiaries continues to decline as they remain out of the labor force while receiving SSDI benefits, then it is unlikely that even very strong work incentives would be able to return long-term beneficiaries to work. Consequently, policy makers might be better off focusing their efforts on relaxing the work disincentives during the SSDI application process and,

[6] Estimates using examiner or judge assignments as instruments for the initial allowance are likely to be biased because applicants assigned to stricter examiners are more likely to appeal their initial denials, leading to longer application times and further reductions in employment potential (bearing in mind that those initially allowed benefits do not appeal their decisions). Thus, marginal applicants who are ultimately denied benefits due to variation in examiner leniency suffer greater losses in work capacity than marginal allowed applicants, leading to an underestimate of the direct effect of the SSDI award on subsequent employment.

more generally, on providing alternatives to potential beneficiaries on the margin between work and program participation that would prevent them from coming into contact with the SSDI program in the first place.

Finally, our findings contribute to a longstanding and active literature on duration dependence in unemployment (Kroft, Lange, and Notowidigdo 2013, Davis and von Wachter 2011, Ljungqvist and Sargent 1998, and Blau and Robins 1990). While our results pertain most directly to the labor force participation of disability applicants rather than unemployed workers, one can interpret our findings more broadly to indicate that involuntary time out of the labor force exerts an adverse causal effect on subsequent employment of workers with marginal employment prospects. While we hypothesize that this decay channel operates through deteriorating human capital, it may also plausibly be explained by workers losing their taste for employment during periods of non-participation, or by employers discriminating against workers who have experienced extended spells of unemployment (as in Kroft et al., 2013).

The paper proceeds as follows. The next section discusses relevant features of the SSDI system and details our research database. Section 2 offers a brief statistical model of the hypothesized delay/decay process, and develops testable empirical implications for the setting that we study. Section 3 lays out our identification strategy, while section 4 presents labor supply results for initially allowed applicants. Section 5 adds initially denied applicants to the sample, and simultaneously estimates the impacts of both processing time and disability award on labor supply. Section 6 concludes.

## 1 Data and Background on SSDI

We make use of a unique workload management database called the Disability Operational Data Store (DIODS) which temporarily stores information about the universe of initial and reconsideration disability decisions that are recorded in the National Disability Determination Service System. The main advantage of the DIODS over other data sets is that it includes alphanumeric codes linking applicants to the disability examiner who was (conditional on observable characteristics) randomly assigned to evaluate their case. Our sample contains data on all initial medical determinations (that is, excluding technical denials) made in 2005. We restrict the sample to primary claimants (i.e., excluding dependents) for adults ages 18-64 assigned to examiners handling at least 10 such cases in 2005 (and fewer than 900 cases to rule out training cases). The DIODS contains applicant characteristics, notably impairment type (i.e., broad body system affected), which can factor into examiner assignment at some DDS offices. Linking the DIODS to SSA's "831" research file (derived from Form SSA-831 which summarizes the result of the disability determination for applicants) also allows us to observe cases of alleged terminal illness (TERI), which are flagged for priority processing, often by examiners who specialize in such cases. Conditional upon these two variables—broad impairment type and TERI—SSDI applications are randomly assigned to examiners. See Maestas, Mullen and Strand (2013) for more details.

In addition to the outcome of the initial disability determination, the DIODS includes application filing date, date of receipt at the regional DDS office (after being forwarded from the local field office), date of the initial determination and, for initially allowed applicants, the disability onset date. We measure examiners' average processing time using recorded time at DDS (date of initial determination minus date of receipt at DDS).

Denied applicants can appeal their initial determination up through four levels: reconsideration, where the application is returned to the original DDS office in most states[7]; a hearing before an administrative law judge (ALJ); a hearing before an SSA Appeals Council; and finally Federal Court. At any stage in the appeals process the applicant can present new evidence. Because appealing an initial denial can add several months and in many cases years to receive a decision, some applicants who appeal may simultaneously submit a new application ("reapplication").

To measure applicants' total processing time, we employ several data sets. We observe reconsiderations and reapplications using a DIODS extract and 831 file, respectively, including decisions through 2006. We observe ALJ hearings through November 16, 2012 using data from the Case Processing and Management System (CPMS). Although we are unable to directly observe cases that proceed to the Appeals Council and/or Federal Court, we can observe date of benefit receipt for cases that were ultimately allowed using data from the Payment History Update System (PHUS) coupled with the Master Beneficiary Record (MBR) to verify that the payments were SSDI payments. We observe these payments through 2011. We measure applicants' total processing time by calculating time from filing date to the last observed decision. We consider any new application filed within one year of the last observed denial (e.g., at the ALJ) to be a continuation of the previous claim (reapplication) and add processing time for that or any following decisions to the applicant's total processing time. For applicants receiving SSDI benefits whose last decision was observed as a denial, we use time to benefit receipt date (inferring that the applicant was allowed through one of the "higher appeals" levels).[8]

Finally, we observe labor market outcomes by linking our sample to the Detailed Earnings Record (DER) that gives uncapped annual earnings from box 5 (Medicare wages and tips) of individuals' W2 tax forms. We observe earnings up to and including 2011. In order to ensure that the earnings records represent a full year of potential work, we link to the date of death information in the Numerical Identification System (NUMIDENT) and restrict the sample to applicants who were alive through the end of the calendar year in which earnings are observed.

Table 1 presents summary statistics on the sample, overall and separately for initial and final allowance decision. After applying our sample restrictions, we observe SSDI applications for just under 1.1 million individuals in 2005. Average examiner processing time average just under three

[7] In 1999, the reconsideration step was eliminated in ten "prototype" states (Alabama, Alaska, California (Los Angeles North and Los Angeles), Colorado (West), Louisiana, Michigan, Missouri, New Hampshire, New York and Pennsylvania). Despite this, we found that mean processing times were virtually identical in prototype and non-prototype states, largely because more applicants in the prototype states initiated appeals.

[8] According to the Office of Disability Program Management Information, around 2 percent of claims are denied at the appeals council and federal court levels. For these and any claims in process more than 7 years after the initial determination, we will underestimate true processing time.

months and does not differ systematically across applicant groups according to case disposition (columns 2 - 5): those initially allowed, those initially denied, those finally allowed, and those finally denied. Approximately one-third of applicants are initially allowed benefits, although more than two-thirds are observed to receive SSDI benefits by the end of 2011. This is largely due to the appeals process. Sixty-four percent of initially denied applicants continue their claim by either pursue an appeal or submitting another application. Of these, the vast majority (more than 95 percent) pursue an appeal and 70 percent of these are ultimately successful. In contrast, reapplication appears to be a poor strategy for continuing a claim; 16 percent of initially denied applicants submit a new application (most—74 percent—while simultaneously pursuing an appeal), yet only 12 percent of these are successful.

Approximately half of SSDI claims are concurrent with claims for Supplemental Security Income (SSI), which pays additional benefits to disabled individuals with limited income (counting SSDI) and assets. Applications are assigned to examiners and evaluated the same way for concurrent and non-concurrent applications. Fewer than 1 percent of applications are flagged as high priority terminal illness cases, and these cases have disproportionately high (initial) allowance rates. On average, applicants are 47 years old at the time of their initial determination and have low pre-onset earnings—$22,427 (in 2008 dollars) averaged over the 3-5 years prior to initial determination. Earnings and employment (measured as earning more than $1,000 per year) are also low 2-6 years after initial determination and falling over time.

Table 2 presents average cumulative application processing times by administrative level. On average, an applicant receives an initial determination in just under four months. (About one month is spent at the field office on average.) The median initial processing time is 3.4 months and 90 percent of applications are processed at this stage in under 6.2 months. Just over a quarter of applications enter reconsideration, which adds just over five months on average. About a third of applicants participate in a hearing at the ALJ level, which adds more than two years to average cumulative processing time. A very small fraction of applicants receive benefits after appealing a negative ALJ decision, but those who do wait on average an additional twenty months—almost two more years. Finally, applicants who submit a new application (either after an initial denial or a denial at the reconsideration or ALJ level) also have a lengthy processing time because the vast majority of them also pursue an appeal, which is much more likely to be successful than the new application.

Table 3 presents average final processing times by final outcome. A key takeaway from this table is that the primary driver of total processing time is whether or not an applicant pursues an appeal. Processing time averages 3.7 months both for applicants who were initially allowed and for applicants who were initially denied and did not appeal. In contrast, average processing time is just over 26 months for applicants who pursued an appeal or reapplication, regardless of the outcome. On average, applicants who ultimately received benefits had longer processing times (15.4 months) than applicants who did not (11.6 months). This is because among the ultimately denied applicants only about a third continued their claim after the initial level compared with half of ultimately allowed applicants.

## 2 The Impact of Disability Application on Work Capacity and Work Behavior: A Statistical Model

Here we consider a simple statistical model of how an individual's interactions with the SSDI system may affect observed and latent work capacity. The key assumption of the model is that workers' latent earnings capacity decays with time out of the labor force. Assuming plausibly that workers face non-zero psychic or monetary costs of participating in the labor force, this setup will imply that labor force participation decisions and the evolution of work capacity are path dependent: the more time a worker spends out of the labor force, the more his work capacity decays, the less likely is his subsequent earnings potential to be sufficient to cover the fixed cost of participation. Thus, if SSDI applicants must spend prolonged periods out of the labor market while seeking benefits, they may participate less in the labor force after applying than they did prior to applying, regardless of whether benefits are allowed or denied.

Let $\alpha_{it}$ equal the latent earnings capacity of individual $i$ in time $t$, where latent earnings capacity refers to $i's$ potential earnings in full-time employment. We assume that $\alpha_{it}$ evolves over time as a function of health and time out of work:

$$\alpha_{it} = \alpha_{it-1} - \lambda \times 1\left[Y_{it-1} = 0\right] + \nu_{it}, \tag{1}$$

where $\nu_{it}$ is an iid error term measuring innovations to health, and $Y_{it-1}$ corresponds to $i's$ earnings in the prior month. This specification implies that health follows a random walk: health evolves stochastically over time, the direction of its evolution is not forecastable so long as an individual is working, and the best forecast for a worker's health tomorrow is his health today. The term $\lambda \geq 0$ multiplying the indicator designating non-participation in the previous period, captures the key hypothesis that we test in this paper: work capacity deteriorates with time spent out of the labor force. Specifically, for each month out of the labor force ($Y_{it} = 0$), an individual's expected work capacity declines by $\delta$:

$$E\left[\alpha_{it}\left|\alpha_{it-1}, Y_{it-1}\right.\right] = \left\{ \begin{array}{ccc} \alpha_{it-1} & \text{if} & Y_{it-1} > 0 \\ \alpha_{it-1} - \lambda & \text{if} & Y_{it-1} = 0 \end{array} \right\} \tag{2}$$

Workers face a fixed cost $\pi > 0$ of participating in the labor market in each period, so that an individual whose earnings capacity falls at or below $\gamma$ does not work.[9] Unconstrained earnings are

[9] We have simplified the environment by assuming that workers' participation decisions do not account for the option value of ongoing employment. In a forward-looking environment, workers would optimally select a participation threshold $\gamma'$ that is lower than the fixed cost of participation $\gamma$, and hence would participate even when $\gamma' < \alpha_{it} \leq \gamma$ so as to avoid further losses of earnings capacity. Since our setup assumes a stationary environment and an infinite time horizon, workers' optimal choice of $\gamma'$ would be a constant (akin to $\gamma$), and so this extension would not affect the analytics of the model.

therefore:

$$Y_{it} = \left\{ \begin{array}{ccc} \alpha_{it} & \text{if} & \alpha_{it} > \pi \\ 0 & \text{if} & \alpha_{it} \leq \pi \end{array} \right\}. \tag{3}$$

A key implication of this setup is that if a negative health shock ($\nu_{it}$) reduces a worker's earning capacity below $\pi$, he will exit the labor force and his earnings capacity will deteriorate further in expectation by $\lambda$ in each subsequent period he remains a non-participant. Conversely, a positive health shock that restores a worker's earnings capacity above the threshold of $\alpha_{it}$ will spur a return to work, halting the process of deterioration.

The question explored by our paper is how a worker's interaction with the disability system affects earnings capacity and labor supply. We assume that workers apply for SSDI when the fixed cost of work exceeds earnings capacity ($\pi$). We write the effect of SSDI application and receipt on earnings of those applying for or receiving disability as follows,

$$\tilde{Y}_{it} = \left\{ \begin{array}{ccc} Y_{it} & \text{if} & SSDI_{it}, APPWAIT_{it}, EXAMWAIT_{it} = 0 \\ \min\left[Y_{it}, SGA\right] & \text{if} & SSDI_{it} = 1 \\ 0 & \text{if} & APPWAIT_{it} = 1 \text{ or } EXAMWAIT_{it} = 1 \end{array} \right\} \tag{4}$$

where $\tilde{Y}_i$ denotes earnings of SSDI applicants and recipients. Three distinct groups are described by this equation. Workers who are neither receiving SSDI nor awaiting a decision have unconstrained earnings, as above. Workers who have obtained benefits ($SSDI_{it} = 1$) will generally elect to keep earnings at or below the Substantial Gainful Activity ($SGA$) level even if they have regained capacity since prolonged earnings in excess of $SGA$ will jeopardize benefits.[10] Critical to our analysis is the set of applicants who are currently in the five-month waiting period for SSDI benefits ($APPWAIT_{it} = 1$) or are waiting on a disability examiner's decision ($EXAMWAIT_{it} = 1$). These workers will generally not participate in the labor force ($Y_{it} = 0$) for one of two reasons: either because their latent earnings capacity remains below the participation threshold ($\alpha_{it} < \pi$), in which case their non-participation is involuntary; or alternatively, because they have regained work capacity but remain voluntarily out of the labor force to maximize the perceived odds of receiving an award.[11] Thus, of the three groups

[10] While a small percentage of SSDI recipients earns in excess of SGA in each month, most reduce their earnings to SGA subsequently, likely so as not to disqualify themselves from future benefits (Ben-Shalom et al., 2012). To simplify the model, we assume that the SGA bound does not directly lead to labor force withdrawal, which would occur if $SGA < \gamma$.

[11] Although SSA policy allows that SSDI applicants may earn up to the Substantial Gainful Activity level during the application process without disqualifying their application, many claimant representatives advise claimants that working during the application period reduces the odds of receiving an award. For example, the website disabilitysecrets.com, run by nolo.com, which sells do-it-yourself legal guides, counsels, "The mere fact that you are working, even if you are making less than $1,040 per month, may influence the attitude a disability claims examiner or a disability judge as your claim is being considered. For this reason, many disability lawyers and representatives will advise their clients not to work while their case is pending" ( http://www.disabilitysecrets.com/page1-13.html, accessed 6/13/2013). The largest disability law firm in the U.S., Binder and Binder, offers similar advice on its FAQ page: "Am I allowed to work or earn money while this case is pending? Yes and no. It is not uncommon for someone to have had a heart attack, be out of work four or five months, try to go back to work, work a few weeks, and then be unable to do it. That would be considered by most judges to be a "unsuccessful work attempt," and would not preclude you from getting paid your SS benefits even for that period of time that you were working... However, if you've still managed to work in spite of significant health problems and you are working 25 or 30 hours per week, then I know

described by (4), the first has no earnings constraints, and the second and third are constrained at SGA and zero respectively. We emphasize that these constraints are not absolute: SSDI recipients may choose to work above SGA and ultimately exit SSDI; SSDI applicants may choose to participate in the labor force while applying for SSDI, even if substantial work activity reduces their odds of receiving an award. These constraints should therefore be thought of as economic incentives rather than fixed caps per se.

Equation (4) highlights three mechanisms through which the SSDI program may affect the work potential, $\alpha$, and labor force participation, $\tilde{Y}$, of applicants and beneficiaries. A first is that it discourages labor force participation among SSDI applicants during the waiting period and during any subsequent months while applicants await determination. If benefits are awarded, a second channel by which SSDI affects labor supply is through the $SGA$ earnings cap: recipients who have regained substantial work capacity following their benefits award ($\alpha_{it} > SGA$) will typically choose to maintain earnings below $SGA$ to retain benefits. Both of these channels provide direct incentives for SSDI applicants and recipients to limit earnings so as to obtain or retain benefits. The third channel is decay: workers who recover earnings capacity during application ($\alpha_{it} > \pi$) will be deterred from obtaining employment while awaiting a determination, and suffer an additional loss of earnings capacity beyond which would have occurred had they not been applying for SSDI benefits. Distinct from the first two channels, the scarring effect of application on subsequent earnings capacity reflects a non-incentive effect; whether or not applicants are ultimately awarded benefits, their loss in earnings capacity during the determination process reduces the odds that they *subsequently* participate in the labor force.

To consider how this non-incentive channel may be identified empirically, we employ a tractable functional form for the error process in (1) whereby *iid* health innovations are drawn from $\nu \sim N(0, \sigma)$ with $\sigma > 0$. We assume for expositional simplicity that all SSDI applicants have earnings capacity of $\alpha_{it} = \pi$ at the time of labor force exit—that is, earnings capacity has fallen precisely to the level that induces labor force withdrawal.[12] To fix ideas, observe that if earnings capacity did not decay with time out of the labor force ($\lambda = 0$) and if were there no SSDI program, fifty percent of potential applicants would regain work capacity and reenter the labor force in the period following withdrawal.[13] With $\lambda > 0$, and continuing to assume that there is no SSDI program, the

of no judge who is going to pay you SS benefits no matter how sick you are. Those who struggle to work generally will have a harder time winning than those who simply stop early on" (http://www.binderandbinder.com/Social-Security-Disability/FAQs-About-Social-Security-Disability.shtml#QBM7, accessed 6/13/2013). Because our data do not permit us to observe earnings at sub-annual frequency, we cannot determine what fraction of applicants have zero earnings while awaiting a determination. Our operative assumption, however, is that the vast majority of SSDI applicants will choose not to participate in the labor force to any significant extent while awaiting a determination. Consistent with this assumption, Lindner (2013) documents that 71 percent of SSDI applicants do not work while applying for benefits.

[12]This error structure implies that the standard deviation of cumulative innovations to health from periods $t$ to $T$ is $\sqrt{E\left(\sum_{t=t}^{T} \nu_t^2\right)} = \sigma\sqrt{T-t}$.

[13]As per our earlier discussion in footnote 9, this decision rule does not account for the option value of remaining employed as a mechanism for preserving earnings capacity. Accounting for option value, the threshold value of $\alpha_i$ required for a worker to seek SSDI benefits would be lower than the threshold for labor force participation. In our stationary, infinite time horizon environment, this threshold would also be time invariant.

probability that a potential applicant regains work capacity and return to work the month following withdrawal is $\Pr\left[\nu_{it} - \lambda > \pi - \alpha_{it-1}\right]$, which may be rewritten as $\Phi\left(-\lambda/\sigma\right)$, where $\Phi\left(\cdot\right)$ is the CDF of the standard normal distribution. This probability is below fifty percent due to the deterioration in work capacity following labor force withdrawal.

Consider a large population of disability applicants who are individually randomly assigned to one of three examiners. These examiners take four, five or six months respectively to make a determination. To abstract from reapplications, assume that all applicants are awarded benefits following the determination. How will labor force participation differ among these three groups of applicants following award? Although the applicants assigned to the first examiner spend one month less awaiting a decision than those assigned to the second examiner, both groups face the incentive to remain out of the labor force during the five-month waiting period. Using the normality of $\nu$, we calculate that the proportion of applicants expected to rejoin the labor force in the month following the determination is:

$$\begin{aligned}\Pr\left[\tilde{Y}_{it} > 0 \middle| \alpha_{it-5} = \pi, \left\{\widetilde{Y}_{it-5}, \widetilde{Y}_{it-4}, ..., \widetilde{Y}_{it-1}\right\} = 0\right] &= \Pr\left[\sum_{t=-4}^{t=-0} \nu_{i,t} > 5\lambda\right] \\ &= \Phi\left(-\frac{\sqrt{5}\lambda}{\sigma}\right). \end{aligned} \tag{5}$$

Similarly, for applicants who are randomly assigned to the six-month examiner, the probability of rejoining the labor force in the month following the determination is:

$$\Pr\left[\tilde{Y}_{it} > 0 \middle| \alpha_{it-6} = \pi, \left\{\widetilde{Y}_{it-6}, \widetilde{Y}_{it-4}, ..., \widetilde{Y}_{it-1}\right\} = 0\right] = \Phi\left(-\frac{\sqrt{6}\lambda}{\sigma}\right),$$

which is below the probability in (5) above. Thus, assignment to a slower examiner reduces subsequent employment. More generally, the effect of an additional month of incentivized non-participation in the labor force on the *subsequent* probability of labor market reentry in the month in which the constraint is relaxed is

$$\frac{\partial \Pr\left[Y_{iT+1} > 0\right]}{\partial \widetilde{Y}_{iT} = 0} \Bigg| \left\{\alpha_{it} = \pi, \left\{\widetilde{Y}_{it}, \widetilde{Y}_{it+1}, ..., \widetilde{Y}_{iT-1}\right\} = 0\right\} = -\frac{T^{-\frac{3}{2}}}{2\sigma}\phi\left(-\frac{\sqrt{T}\lambda}{\sigma}\right),$$

which is negative and asymptotes to zero as $T \to \infty$.[14]

This simple model has four main empirical implications. First, spells out of the labor force are duration dependent: the longer an individual is out of the work, the more his latent work capacity is eroded. While a positive shock to health may return a non-participant to work, the magnitude of the shock required to reach the threshold is rising with time spent out of the labor force, and hence the likelihood of such a shock occurring is falling. Second, the disability application process directly

[14]Here, $\phi\left(\cdot\right)$ is the PDF of the standard normal. Note that the incentive effect implies that the applicant will not work even if $\alpha_{it} > \gamma$. This constraint is binding for less than half of all applicants at any time, and the fraction is decreasing in the time elapsed since application.

reduces applicants' subsequent odds of labor force participation on average, regardless of whether or not benefits are awarded; thus, the application process induces scarring. Third, for applicants who receive a determination within five months of disability onset (i.e., before the end of the five-month waiting period), variation in examiner speed has no marginal effect on labor force participation after benefits commence. Finally, variation in examiner speed that prolongs determinations beyond five months following disability onset causes further deterioration in applicants' work capacity and hence further reduces the probability of their rejoining the labor force following determination.[15]

## 3 Empirical Strategy

To empirically test for the scarring effect of SSDI application, we begin with a causal model of labor supply:

$$y_i = X_i\beta + \delta T_i + \gamma DI_i + s_i + \varepsilon_i, \tag{6}$$

where $y_i$ is the observed labor supply of applicant $i$ measured 2,4, and 6 years following the initial determination, $X_i$ is a vector of observed individual characteristics that influence labor supply (e.g., age, impairment type), $T_i$ is the applicant's total processing time measured in months from the application filing date to the last observed decision date, $DI_i$ is an indicator for whether the applicant was *ultimately* awarded benefits (i.e., was observed to be a SSDI beneficiary within 6 years of initial determination), $s_i$ represents unobserved factors that affect labor supply such as impairment severity or the degree of labor force attachment, and $\varepsilon_i$ is an idiosyncratic error term. The causal parameters of interest are $\delta$ and $\gamma$, which respectively measure the labor supply decay rate (the loss in labor supply caused by an additional month of application processing time), and the benefit receipt effect (the loss in labor supply caused by receipt of disability benefits). The combined effect of SSDI on labor supply operating through these two causal channels is $\delta T + \gamma$ for an allowed applicant and $\delta T$ for a denied applicant.

A key challenge for consistently estimating $\delta$ and $\gamma$ is that unobserved determinants of labor supply contained in $s_i$ may also affect both application processing time and the ultimate award decision. For example, applications from severely impaired applicants are both more likely to be allowed and more likely to be decided at an earlier decision step (i.e., based on the medical listing criteria at Step 2) than less severe applications, which are both more likely to be denied and more likely to be decided in a later decision step (i.e., based on medical and vocational criteria at Steps 4 and 5) or on subsequent appeal. If processing time is shorter for those with more severe impairments, then the OLS estimate of $\delta$ will be biased towards zero. Intuitively, applicants with shorter processing times will be observed to have relatively low post-decision labor supply (due to their unobservably poor health) while those with longer processing times will have higher post-decision labor supply

[15]The equations above express the probability that an SSDI recipient returns to work in the month following determination; they do not express the expected trajectory of participation following a disability award. This expression is considerably more complicated because of the asymmetry in the trajectory for individuals who return to work (and hence halt the process of deterioration) and those who do not. It is sufficient for our purposes to note that the longer that an applicant is out of the labor force initially, the less likely he is to return to work in any finite period following completion of the determination process.

due to their relatively good health. Thus, estimates of the decay rate would be understate the health-constant adverse effect of additional processing time on subsequent labor supply. Conversely, if processing time is shorter for applicants with stronger labor force attachment because they are more likely to discontinue a claim in favor of returning to the labor force, then the OLS estimate of $\delta$ will overstate the true decay effect. These same factors also confound estimation of the benefit receipt effect. The OLS estimate of $\gamma$ is biased upward to the extent applicants with more severe impairments are both more likely to be allowed benefits and less able to work, and biased downward to the extent applicants with lower labor force attachment are both less likely to be allowed benefits and less likely to ever work.

To overcome these confounds, we employ an empirical strategy similar to that used by Maestas, Mullen and Strand (2013, MMS hereafter) to estimate the effect of SSDI benefit receipt on labor supply ($\gamma$). MMS show that DDS examiners differ in the implicit thresholds that they employ when judging the severity of a disability. All else equal, applications sent to low-threshold examiners are more likely to be allowed than others whereas those sent to high-threshold examiners are more likely to be denied. MMS observe that because applications are randomly assigned to examiners, examiner-specific allowance rates can be used to instrumental variable for the ultimate allowance decision for individual applicants, thereby identifying the causal effect of the allowance decision on subsequent labor supply.

Building on MMS, we take advantage of the fact that DDS examiners also vary considerably in the speed at which they process disability applications—that is, some DDS examiners are considerably faster than others. Using the conditional random assignment of cases to DDS examiners, this natural variation in examiner processing speed during the initial determination phase generates exogenous variation in total processing time (which includes time spent in the appellate phases) that is uncorrelated with unobserved applicant characteristics. Thus, we can use examiner assignment to isolate exogenous variation in applicant processing times that is independent of impairment severity and labor force attachment.

Specifically, in our first stage equation for $T_i$, we use a jackknife instrumental variable, $EXTIME_{j(i)}$, which denotes the average processing time of the examiner $j$ to which applicant $i$ is randomly assigned, excluding applicant $i$'s own processing time:

$$T_i = X_i\beta^0 + \beta^1 \cdot EXTIME_{j(i)} \tag{7}$$

where

$$EXTIME_{j(i)} = \frac{1}{N_{j-1}} \sum\nolimits_{k\neq i,k=1}^{N_j} T_k.$$

Figure 2 shows the empirical variation in $EXTIME$. Although there is wide variation in initial processing times at the applicant level, it does not necessarily follow that there is significant variation in average processing times at the examiner level. To assess this variation, we plot the distribution of examiner processing time expressed as *deviations* from the average processing time across all examiners within the same DDS office. The DDS-office mean processing time is 3 months. Adjusting for case-mix differences[16] tightens the distribution of examiner times, reducing the standard deviation from 1 month to 0.68 months, but there is still significant variation in average processing times across examiners within the same DDS office (adjusted coefficient of variation of .23).

The variable $EXTIME$ is a valid instrument for final decision time under two key assumptions. The first is a monotonicity assumption. Monotonicity requires that cases processed by "fast" examiners would take longer if processed by "slow" examiners. While fundamentally untestable, if it were the case that an examiner was fast on some types of cases but slow on others, then this could potentially give rise to a violation of monotonicity.

The second key assumption is an exclusion restriction. For $EXTIME$ to be a valid instrument for decision time, it must be orthogonal to other factors affecting labor supply. As described in detail in MMS, SSDI applications are randomly assigned to DDS examiners conditional on a small set of "assignment variables"—case information that is identified when the application is transmitted from the field office to a particular DDS, and which could potentially be used in the (computerized) assignment of cases to examiners. This information includes the affected broad body system (mental, musculoskeletal, etc.) and whether the case is eligible for expedited processing (primarily terminal illness cases during our sample period). Conditional random assignment of applicants to DDS examiners ensures that after controlling for assignment variables, individual case characteristics are not correlated with examiner processing speed.

To benchmark the econometric strategy, Table 4 presents first-stage regression estimates of the effect of $EXTIME$ on initial processing time and time until final decision, for the full sample of SSDI applicants and separately for the initially allowed and initially denied. In each column, we display the coefficient on obtained under three different specifications. The first specification is an OLS regression specification with no controls. The second is a specification that includes the assignment variables (DDS indicators, terminal illness flag, and body system code). The third specification further adds applicant characteristics (age, pre-disability earnings, three-digit zip code), and is included as a randomization test—if the coefficient on $EXTIME$ is statistically unchanged upon the inclusion of individual characteristics, then our assumption of conditional random assignment is supported.

In the full sample (column 2), the first-stage coefficient exceeds one when we omit the necessary examiner assignment variables, then falls to 0.962 once they are included. In other words, a one month increase in examiner processing time leads to a nearly one-month increase in applicant time until final decision. The estimate is statistically unchanged once we add applicant characteristics, indicating that $EXTIME$ is indeed uncorrelated with applicant characteristics (after conditioning on the assignment variables).[17] In the initially allowed sample, the first-stage coefficient is 0.848; this attenuation away from 1 does not reflect initially allowed applicants' behavioral response to initial decision time since those allowed benefits do not pursue appeals (thus, their final time is uncensored

[16] We do this by regressing $EXTIME_{j(i)}$ on DDS office indicators and examiner caseload characteristics (3-digit zip code, body system code, terminal illness high-priority flag, age group, average pre-onset earnings and concurrent application status) and plot the residuals from this regression.

[17] The incremental F-statistic = 307, which indicates a strong first stage.

and equal to their initial processing time). Rather, the attenuation is likely due to sampling variation in the construction of $EXTIME$, which is computed over finite examiner caseloads.[18] This suggests that in samples in which appeals are possible, the coefficient on $EXTIME$ should be at least as large as it is in the initially allowed sample. This is indeed the case for the initially denied sample, where the first-stage coefficient is almost unity.[19]

While conditional random assignment breaks the correlation between $T_i$ and $s_i$, there remains the possibility of a correlation between the instrument $EXTIME_{j(i)}$ and the indicator for ultimate allowance, $DI_i$.[20] We investigate this possibility in Table 5, where the rows give results from separate regressions testing whether examiner processing time is correlated with the probabilities of initial allowance, appeal or reapplication, and ultimate benefit receipt. The first row in Table 5 shows that $EXTIME$ has no effect on the probability of initial denial; in other words, slow examiners are no more likely to be lenient or strict than fast examiners. $EXTIME$ is, however, positively correlated with the likelihoods of appeal, reapplication, and ultimate benefit receipt. That is, all else equal, an applicant initially denied by a slower DDS examiner is more likely to appeal than one denied by a faster DDS examiner. This could plausibly arise if an applicant assigned to a slower examiner experiences a greater decay in employability in the initial determination phase, and consequently has a lower opportunity cost of remaining out of the labor force while pursuing an appeal. In any case, this higher likelihood of appeal directly translates into a higher probability of benefit receipt, and a longer final processing time. Assignment to an examiner who is one month slower on average yields a small, but statistically significant increase in the probability of benefit receipt of 0.26 percentage points (0.4%).

This set of results implies that examiner processing time may affect labor supply outcomes both directly, by prolonging final time to determination, and indirectly, by spurring further appeals, some of which lead to subsequent benefit receipt. This indirect effect presents an additional challenge for our estimation because it violates the maintained exclusion restriction, which is that $EXTIME$ affect labor supply only through the channel of processing time. We pursue two solutions to this problem. A first is to note that examiner processing time *is* a valid instrument for final decision time for the initially allowed, because $EXTIME$ affects final time for the initially allowed but is uncorrelated with the probability of ultimate allowance—which in this case is equivalent to initial allowance. Thus a consistent estimate of $\delta$ can be obtained by estimating our instrumental variables model for the initially allowed subsample only. In addition, this subsample offers the possibility of testing the third and fourth implications of our statistical model in Section 2—which is that variation in examiner processing time will adversely affect the labor supply of applicants who receive a favorable determination *after* five months but should not affect labor supply of applicants who receive a favorable determination sooner, since these applicants must still complete the five month

[18] For reference, Table 4 also shows the estimated relationship between the individual's *initial* processing time and $EXTIME_{j(i)}$. These coefficients show a similar degree of attenuation from 1.

[19] In this case, however, applicant behavior can affect final time since the majority of denied applicants appeal their decision.

[20] As noted above, $DI_i$ is also an endogenous regressor correlated with $s_i$.

waiting period before engaging in gainful employment.[21]

Because examiner processing time is not a valid instrument for final decision time among initially denied applicants, our second strategy is to exploit an additional source of variation that affects the likelihood of receiving an SSDI allowance but is uncorrelated with either applicants' health or their initial processing times. Following Maestas, Mullen and Strand (2013), we use variation in examiner allowance propensity as this second source of variation. The random assignment of applicants to disability examiners with different allowance propensities generates exogenous variation in decision outcomes that is unrelated to unobserved impairment severity or labor force attachment. We therefore estimate $\delta$ and $\gamma$ in Equation (6) simultaneously using $EXTIME_{j(i)}$ as a jackknife instrumental variable for $T_i$ and $EXALLOW_{j(i)}$ as a jackknife instrumental variable for $DI_i$. The construction of $EXALLOW$ parallels that of $EXTIME$ and is described in detail in MMS. Figure 4 plots both sources of variation, examiner processing speed and examiner allowance propensity, and visually corroborates the regression result from Table 5 that these attributes of examiner behavior are uncorrelated in our sample.[22]

Table 6 documents the operation of this identification strategy by presenting a set of first stage estimates for processing time and ultimate SSDI allowance, estimated jointly. In the full sample of applicants (combining those initially allowed and denied), applicants assigned to more lenient examiners and slower examiners are ultimately more likely to receive an allowance (column 1). These effects operate through different channels, of course: examiner leniency directly affects the probability that an applicant receives an initial allowance, while slower examiner speed indirectly raises the probability of an eventual award by raising the probability of appeal. Column (2) shows that applicants assigned to more lenient examiners have substantially lower total processing times—since an initial allowance obviates the need for appeal—while, as per earlier estimates, each additional month of delay induced by examiner assignment ultimately extends total application time by close to one month.

## 4 Do Processing Delays Affect Labor Supply of SSDI Beneficiaries?

We first present estimates of the processing time effect for the subsample of initially allowed applicants, and subsequently consider the joint effects of processing time and benefit receipt for all SSDI applicants. Because the examiner processing time instrument is uncorrelated with the ultimate allowance decision for those who are initially allowed (Table 5), we can test for a scarring effect of the

[21] This is also an important identification test for our research design; evidence of an effect when there should be none would point to a violation of the exclusion restriction assumption. This particular test is only possible for the initially allowed, since only the initially allowed have a recorded onset date (which is necessary to compute the length of the waiting period) in the SSA administrative data. We present estimates of the decay effect for the initially allowed subsample and the associated identification test in Section (4).

[22] The figure plots the residuals of both examiner time and allowance propensity, each adjusted for the DDS assignment variables and applicant level covariates that are used in the regression analysis. Our identification strategy for initially denied applicants does not require that examiner time and allowance propensity are uncorrelated since we can account for both factors in our analysis. Such a correlation would be problematic for our analysis of initially allowed applicants, however, since it would imply that examiner processing time and the health of allowed applicants are confounded.

application process on SSDI beneficiaries specifically without having to instrument for the ultimate allowance decision. Moreover, by comparing the decay effect for the initially allowed with our estimates for the whole sample (presented in Section 5), we can readily deduce whether the decay effect appears to be different for the initially allowed and denied. Finally, the fact that examiner processing time is non-binding for the subset of allowed applicants who receive their decision prior to the end of their mandatory 5-month waiting period allows us to implement an informative falsification test of our identification strategy using only initially allowed applicants.

### 4.1 The effect of processing time for the initially allowed

Table 7 presents presents OLS and 2SLS estimates of the effect of processing time on the employment and earnings of the initially allowed, measured at 2 to 6 years following their initial decision in 2005. The OLS estimates in Panel A indicate that each additional month of processing time is associated with a reduction in employment (measured as annual earnings of at least $\$1,000$) of 0.21 percentage points 2 years later. This association persists for at least 6 years (through the end of our follow-up period in 2011). These associations should not be taken as causal since, as discussed above, observed claimant-level variation in processing times may reflect both exogenous and endogenous factors, most importantly applicant health. Indeed, among initially allowed applicants, it is plausible that applicants with the highest mortality rates are allowed more quickly by DDS examiners. This would bias OLS estimates towards underestimating the effect of processing time on subsequent employment—since those least able to work would receive faster awards.

Instrumental variables estimates of the impact of processing time on labor supply using the examiner instrument $EXTIME$ are consistent with this reasoning. We find that an additional month of processing time causes a 0.35 percentage point reduction in employment 2 years later and beyond. These point estimates are approximately 60 percent larger in magnitude than the corresponding OLS estimates. Using as the dependent variable employment above SGA (Panel B), we find an additional month of processing time reduces labor supply 2 years later by 0.11 percentage points. Although the effect is imprecisely estimated, the point estimate is virtually identical to the statistically significant estimate we obtain for the full population of applicants (see Table 10, Panel B). Here, the 2SLS estimates are approximately the same as the OLS estimates across all years, though precision is also limited. Finally, we show in Panel C that processing time causes a reduction in earnings of approximately \$50 to \$75 annually during the 6-year follow-up period for each month of processing delay during the initial application period. Again, the point estimates are not statistically significant in all years, but they are comparable to the statistically significant estimates we obtain in all years for the full applicant population (see Table 10, Panel C), which suggests that their imprecision may stem from low statistical power rather than lack of a causal effect per se.

## 4.2 Testing the identification strategy using the five month waiting period

To qualify for SSDI, applicants must demonstrate that they are unable to perform substantial gainful activity for at least 5 months before benefits may commence. This programmatic requirement suggests an identification test for our research design: for applicants who are awarded benefits within five months of disability onset, examiner speed should have no marginal effect on labor force participation after benefit payments begin. Thus, evidence of an examiner time-induced decay effect among applicants awarded benefits within five months would point to a violation of the exclusion restriction assumption.[23]

To perform this test, we begin by partitioning total processing time into two components: time during which examiner delays are non-binding constraints on labor supply (i.e., during the mandatory waiting period) and time during which examiner delays are binding constraints (i.e., time after the waiting period).[24] Figure 4 shows three possible cases. In the first case, the applicant files for benefits shortly after disability onset, and the allowance decision comes *before* the applicant's remaining waiting period has elapsed. Since the applicant cannot work before the end of the waiting period (and the start of the Trial Work Period), examiner processing time has no marginal effect on labor supply. Approximately one-quarter of initially allowed applicants in our sample are in this category. In the second case, the applicant files shortly after onset, but the allowance decision comes *after* the applicant's remaining waiting period has elapsed. This describes another one-quarter of initially allowed applicants. For these applicants, every additional month of examiner delay results in an additional month in which labor force non-participation is potentially constrained (and in which the start of the Trial Work Period is delayed). In the third case, the applicant files for benefits substantially after the onset of disability (perhaps after a period of unemployment), so the waiting period is satisfied at the time of application. For this group, which encompasses approximately one-half of initially allowed applicants, examiner time is fully binding on potential labor supply for applicants who would otherwise work.

To bring these observations to the data, we modify equation (6) as follows

$$Y_i = \delta_0 \min\left[\text{decision\_time}_i, \text{wp}_i\right] + \delta_1 \max\left[\text{decision\_time}_i - \text{wp}_i, 0\right] + s_i + \varepsilon_i, \qquad (8)$$

where

$$\text{wp}_i = \min\left[\text{time\_to\_app}_i, 5\right].$$

In equation (8), $\text{decision\_time}_i$, measures total time from disability onset to final decision, $\text{time\_to\_app}_i$ measures time between disability onset and filing, $\text{wp}_i$ measures how much of the five month waiting period has elapsed prior to $i's$ application, and as before $s_i$ is unobserved severity or labor force attachment and is likely correlated with both total decision time and the time it takes

[23] This particular test is only applicable to the initially allowed: only allowed applicants need satisfy the waiting period, while initially denied applicants who appeal their determination will almost universally wait longer than five months for a final allowance.

[24] Note that these constraints are only binding for the subset of applicants who would otherwise wish to participate in gainful employment.

the applicant to file after disability onset. Since the five-month waiting period begins with the date of disability onset and therefore precedes the filing date, the function $\text{wp}_i$ measures how much of applicant $i's$ waiting period has already been satisfied as of the filing date.[25] Our hypothesis is that variation in examiner processing time that occurs during an applicant's five-month waiting period should have no impact on subsequent labor force participation (hence $\delta_0 \simeq 0$) whereas variation in examiner processing time that effectively prolongs the waiting period will adversely affect post-application employment (hence $\delta_1 < 0$).

In partitioning processing time in this manner, we impose a nonlinearity in our endogenous regressor $T_i$, which complicates instrumental variables estimation. We accordingly implement a control function approach: to account for the endogenous component of $\text{decision\_time}_i$, we include in (8) the residuals from our first stage regression of total processing time on $EXTIME_{j(i)}$ (obtained from (7)). To control for the endogenous component of $\text{wp}_i$ (time from onset to application), we include $\text{time\_to\_app}_i$ itself, which we can compute from our data.

Table 8 reports the estimated effect of examiner processing time that occurs before and after the waiting period on applicants' subsequent labor supply using the control function specification. Additional processing time *before* the waiting period has elapsed causes no incremental reduction in employment 2, 4, or 6 years after the initial decision. Consistent with expectations, the point estimates for $\delta_0$ are statistically indistinguishable from zero, and in two of the three years they are in fact positive. In sharp contrast, an additional month of processing that occurs after the applicant has satisfied the waiting period causes a 0.43 percentage point reduction in employment 2 years later, and this effect persists with approximately constant magnitude through years 4 and 6 years. Thus, this evidence is strongly consistent with the implications of our identification strategy. It is also noteworthy that the estimated decay effect for applicants that face binding constraints on labor supply is larger than the effect for all initially allowed applicants (Table 7). This result is expected because the estimated causal effect for all applicants in Table 7 averages the null effect for the unconstrained group with the somewhat larger effect for the constrained group. When we focus only on the constrained group, we therefore obtain a larger causal effect estimate.

# 5 The Effect of Delay on Allowed and Denied SSDI Applicants

## 5.1 Estimates using allowed and denied applicants

We now broaden the inquiry to incorporate initially denied SSDI applicants. Table 9 presents our main estimates of equation (6) for employment and earnings outcomes at years two through six following initial application. Focusing first on the processing time estimates, the three panels of the table document that application delays lead to significant declines in the probability that applicants' annual earnings exceed either $1,000 (Panel A) or annual SGA (Panel B), and significant reductions in average annual earnings. Since denied applicants' incentives to participate in the labor force

[25] In SSA's administrative data, only allowed applicants have recorded an established onset date, which is necessary to compute the length of the waiting period.

post-denial are not shaped by SSDI program rules, one might have anticipated that the magnitude of the delay-decay channel would be larger for denied applicants. Table 10 finds instead that the effects of processing time in the full sample of applicants are almost identical to those among initially allowed applicants (Table 7).[26] Specifically, we estimate that each additional month of processing time reduces the probability of earnings in excess of $1,000 or in excess of SGA by approximately 0.25 percentage points and 0.13 percentage points, respectively, at year six following application, and reduces annual earnings by approximately $50.

How large are these effects? Noting that total processing time averages 11.6 months among applicants who are finally denied benefits (Table 3), the Table 10 estimates imply that processing delays reduce the probability of applicants earning in excess of $1,000 or SGA by 2.8 and 1.5 percentage points respectively, and lower annual earnings by $610. Relative to observed labor supply of denied applicants, these effects are economically significant. Annual earnings six years post application average $7,900 among finally denied applicants, with only 41 percent exceeding $1K, and only 25 percent exceeding SGA. Thus, we estimate that a one year processing delay reduces subsequent earnings of denied applicants by approximately 8 percent, and the probability of substantial work activity by 6 to 7 percent. The fact that the causal effects of processing delays (in absolute not relative terms) are comparable for allowed and denied applicants may suggest that delays particularly reduce subsequent labor supply among those with the strongest labor force attachment, those whose work behavior would not have been substantially affected by the SSDI program incentives had they been awarded benefits.

The second row of each panel of Table 9 reports estimates of the causal effect of SSDI allowances on labor supply. An SSDI allowance lowers the probability of employment—that is, annual earnings of at least $1,000—by 48 percentage points in year 2 following application, by 32 percentage points in year 4, and by 29 percentage points in year 6. Of course, $1,000 is a very low benchmark for earnings, and it's not clear whether earnings near this threshold should be viewed as economically consequential. Panel B, however, shows that the effect of an SSDI allowance on the probability of annual earnings in excess of SGA—approximately $12,000—is approximately 60 percent as large as its effect on any earnings: a reduction of 29 percent in year 2 and 19 percent in years 4 through 6. As shown in Panel C, earnings reductions stemming from marginal SSDI awards average $8,100 in year 2 following application, $4,900 in year 4, and $5,100 in year 6. Relative to the observed annual earnings of those who are finally denied (column 5 of Table 1), these point estimates imply reductions on the order of 60-plus percent of annual earnings.

In the policy debate surrounding the causes and consequences of the rapid growth of the U.S. SSDI program since 1990, one of the most widely noted phenomena is the rising share of all allowances accounted for by just two categories of impairments: mental disorders and musculoskeletal disorders. In 2009, these two impairments accounted for 54 percent of all SSDI awards, and this share has been trending up for decades. In 1981, for example, only 27 percent of all SSDI allowances were made for mental and musculoskeletal disorders (Autor and Duggan, 2010). MMS find that applicants on

[26] Estimates that allow for separate processing time effects for denied and allowed applicants do not find significant differences.

the margin of allowance are substantially more likely to be young, have very low prior earnings, and suffer from mental disorders. Applicants with musculoskeletal disorders are more likely to have their cases initially denied and therefore proceed to the hearing level (von Wachter, Song and Manchester, 2010; MMS, 2013).

To shed light specifically on the consequences of the SSDI adjudication system on the labor supply of these two groups, Table 10 present estimates for the effects of processing delays and SSDI allowances on applicants whose primary reported impairment is a mental disorder (Panel A) or musculoskeletal disorder (Panel B). For the approximately 20 percent of applicants who claim disability due to a mental disorder, we estimate substantial labor supply effects of both delays and benefits allowances. In year 2, we estimate a delay coefficient of $-0.40$ percentage points per month and an award coefficient of $-50$ percentage points. These point estimates are only slightly larger than the corresponding full sample estimates of $-0.36$ percentage points and $-48$ percentage points. Distinct from the full sample estimates (Panel A of Table 9), however, the magnitude of these causal effects only modestly attenuates in subsequent post-application years. In year 6 following application, we obtain a delay coefficient of $-0.34$ percentage points per month for claimants with mental impairments, and an award coefficient of $-40$ percentage points. Both point estimates are approximately 40 percent larger than the corresponding estimates for the full sample, suggesting that applicants on the margin of allowance with mental disorders experience an above average reduction in labor force participation as a consequence of their interactions with the SSDI system.

By contrast, the estimates in Panel B for the impacts of processing delay and benefits allowances on the labor supply of the approximately 40 percent of applicants claiming a musculoskeletal disorder generally find comparable delay effects relative to the full sample but substantially smaller allowance effects. In particular in years 2, 4 and 6 following application, we estimate that an SSDI award reduces the probability of labor force participation by 41, 25, and 20 percentage points respectively for applicants with a musculoskeletal disorder. These point estimates average 7 to 9 percentage points (25 to 30 percent) below those for the full sample. Noting that the decay effects for applicants with musculoskeletal disorders are comparable to those for the full sample, these results imply that applicants with musculoskeletal disorders have relatively low work capacity at the time of application.[27]

### 5.2 'Processing time bias' in the estimated effect of SSDI allowances on labor supply

A critical implication of the results above for existing literature on the labor supply effects of the SSDI program is that studies that estimate the effect of disability allowances on labor supply but do not account for systematic differences in processing time between allowed and denied applicants will generally produce biased causal estimates. Concretely, the fact that SSDI applicants assigned to slower examiners are more likely to appeal their denials and, ultimately receive allowances (Table 5),

[27] These results echo those of MMS 2013 (Table 6), who find that SSDI allowances result in the largest labor supply reductions for applicants with reported mental impairments and smaller labor supply reductions among applicants with reported musculoskeletal disorders.

implies that processing time is confounded with award probability among initially denied applicants. Conversely, as MMS 2013 note, because applicants assigned to stricter examiners are more likely to appeal their denials, allowance odds will be confounded with processing times in the full sample of applicants. These observations imply specific biases that will result from various instrumental variables strategies. Instrumenting for processing time using examiner speed without also instrumenting for allowance odds will overestimate the causal effect of processing time on labor supply because longer initial processing times increase the odds of an allowance, which itself depresses labor supply. Similarly, instrumenting for allowance odds using examiner leniency without accounting for processing times will underestimate the causal effect of allowances on labor supply: applicants assigned to more lenient examiners are more likely to receive an allowance, which reduces labor supply, but spend less time awaiting a decision, which increases labor supply—and vice versa for applicants assigned to less lenient examiners. Thus, the contrast between the two groups will understate the direct effect of allowances on labor supply.

How large is this 'processing time bias?' We benchmark its magnitude in Table 11 by comparing three sets of point estimates for the association between allowances and employment (earnings of at least $\$1,000$) at years 2, 4 and 6 following application. The first column of the table presents simple OLS comparisons of allowed and denied applicants, akin to those first reported by Bound (1990). Though Bound argued that such comparisons would place an upper bound on the effect of SSDI allowances on labor supply—since allowed applicants are presumably less healthy than denied applicants—recent literature has questioned this interpretation since rejected applicants may differ not only in health but also in their skills and motivation to participate in the labor force. The second column of estimates implements the instrumental variables strategy used in recent literature whereby allowances are instrumented with examiner leniency as in MMS 2013, which in turn is closely akin to the strategy of instrumenting allowances using Administrative Law Judge leniency (French and Song, forthcoming). Following our reasoning above, we would expect these instrumental variables estimates to *underestimate* the causal effect of allowances on labor supply because they do not account for the fact that applicants assigned to less lenient examiners or ALJs have both lower allowance odds and *longer* processing times. Finally, the third column of Table 11 presents our preferred estimates (akin to Table 9) where both processing time and allowance odds are instrumented by examiner speed and leniency.

The Table 11 results indicate that 'processing time bias' is of first order importance. A comparison of the column 1 and column 2 estimates would naively suggest that OLS comparisons of allowed and denied applicants overstate the causal effects of allowance on labor supply, consistent with the influential argument of Bound (1990). Our reasoning implies instead that the column 2 estimates—which instrument for allowances using examiner leniency but do not account for the indirect effect of leniency on waiting times—are likely to underestimate the direct effect of allowances on work. The column 3 estimates, which instrument for both variables, corroborate this contention. In year 2, 4, and 6 following application, the column 3 estimates of the causal effect of allowance on labor force participation, holding processing time constant, is larger than the either the conventional

2SLS estimate or the canonical OLS estimate. Comparing across the rows of Table 11 indicates that the conventional 2SLS estimates understate the causal effect of allowances on labor supply by approximately half. Moreover, the proportional gap between these estimates and the processing time-constant estimates (column 3) rises with time following application, reflecting the fact that processing delays cumulates in the years following initial application as those initially denied pursue further layers of appeal.

On net, our results imply that neither the recent nor established SSDI literature has fully captured the labor supply impacts of the disability system on applicants and beneficiaries. Though prior literature has posited that the decay channel may be economically important (Parsons, 1991), no prior paper has provided direct estimates of this causal pathway. Moreover, due to the confounding of allowance odds and processing times, existing literature has underestimated the labor supply effects of SSDI awards on beneficiaries. Accounting for both mechanisms provides a more complete—and economically more sizable—picture of the aggregate labor supply impacts of the Social Security Disability Insurance program.

## 6 Conclusions

A well-known body of research explores how the award of SSDI benefits affects the labor supply and earnings of recipients. In this paper we explore a complementary—and we believe equally consequential—question: how do long application processing time, during which applicants must not earn more than $1,000 per month, affect the subsequent employment of denied applicants and SSDI beneficiaries? Our approach exploits exogenous variation in average processing time by disability examiners as an instrument for applicant waiting time. Using a unique administrative workload database, we evaluate how the substantial time spent out of the labor market during the application and appeals process—more than one year on average, across all applicants—affects subsequent employment opportunities and earnings of both allowed and denied applicants.

We find that longer processing times significantly reduce the employment and earnings of SSDI applicants in the years after their initial decision. Our main estimates indicate that a one standard deviation (2.4 months) increase in initial processing time reduces annual employment rates by about 1 percentage point (3.2%) in the years following the initial determination. Extrapolating these effects to total applicant processing times, we estimate that the SSDI determination process directly reduces the post-application employment of denied applicants by approximately 4.1 percentage points (8%) and allowed applicants by approximately 5.5 percentage points (38%).

The literature to date comparing allowed and denied SSDI applicants has been exclusively focused on estimating the causal effect of benefit receipt on labor supply outcomes. Importantly, this paper presents the first causal estimates of the labor supply decay effect, which is an additional cost of the SSDI determination process. We show that the decay effect is a distinct causal channel through which the SSDI program impacts post-application labor supply outcomes. Combining the labor supply decay effect (4.4 percentage points for the average applicant) with new estimates of the benefit receipt effect that are purged of waiting time bias (averaging 30 percentage points) suggests that the SSDI program effect on employment is nearly 75 percent larger than previous estimates have suggested.

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Figure 1. Conceptual Sketch of the Effects of SSDI Processing Time and Benefit Receipt on Labor Supply

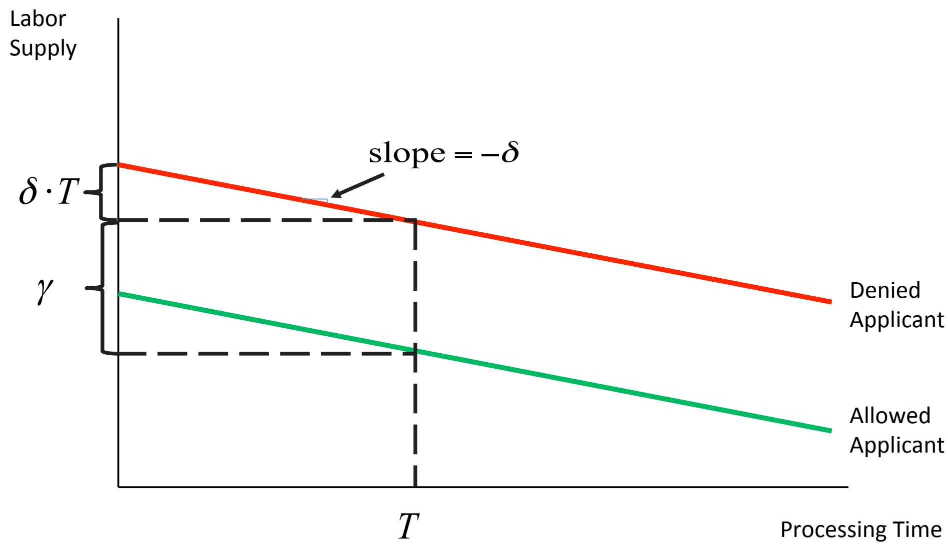


Figure 2. Distribution of Examiner Mean Processing Times

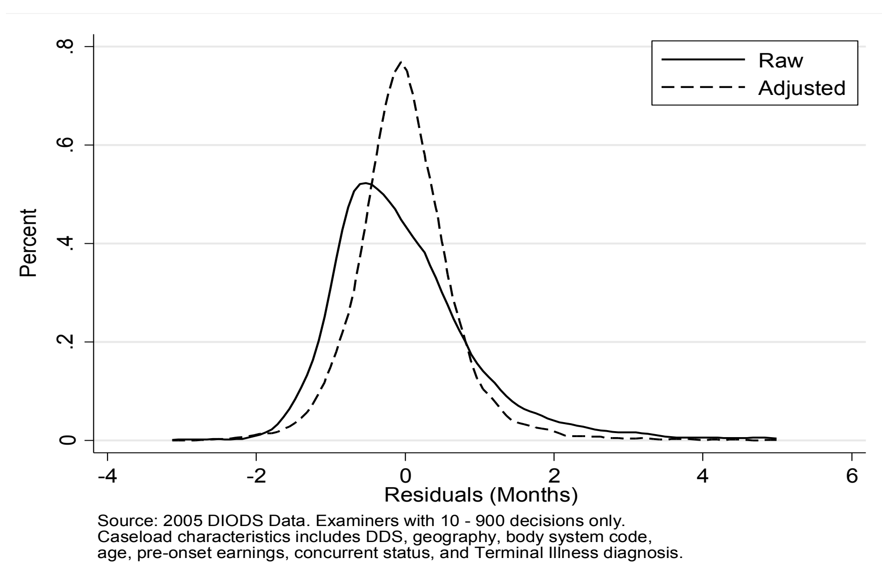

Figure 3. Examples of Non-binding and Binding Processing Time

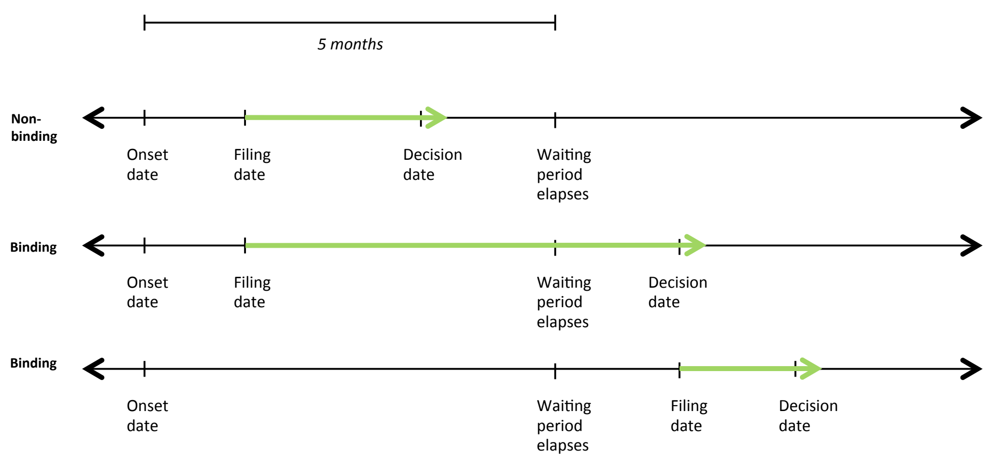


Figure 4. Scatter Plot of Residualized Examiner Allowance Rate and Residualized Examiner Waiting Time

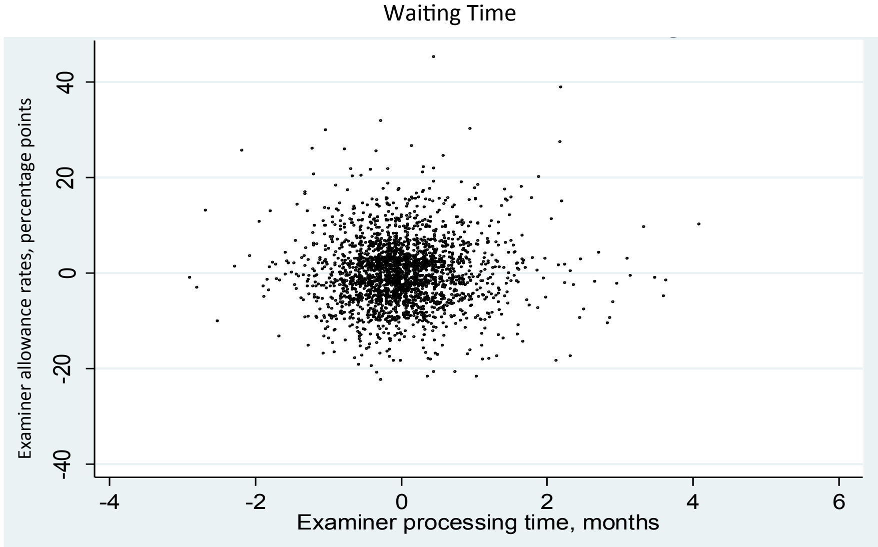

**Table 1. Summary Statistics**

| | All | Initially Allowed | Initially Denied | Finally Allowed | Finally Denied |
|---|---|---|---|---|---|
| % of sample | 100.0% | 33.1% | 66.9% | 67.7% | 32.3% |
| Examiner processing time (EXTIME) | 2.93 | 2.91 | 2.94 | 2.93 | 2.92 |
| | (0.82) | (0.82) | (0.81) | (0.83) | (0.79) |
| Initial allowance rate | 33.1% | 100.0% | 0.0% | 48.9% | 0.0% |
| Continue claim \| initial denial | 64.1% | -- | 64.1% | 91.3% | 35.0% |
| Allowance rate \| continued claim | 69.7% | -- | 69.7% | 94.4% | 0.5% |
| Appeal \| initial denial | 61.2% | -- | 61.2% | 88.7% | 31.7% |
| Allowance rate \| appeal | 70.4% | -- | 70.4% | 93.8% | 0.0% |
| Reapplication \| initial denial | 15.7% | -- | 15.7% | 20.1% | 10.9% |
| Allowance rate \| reapplication | 12.5% | -- | 12.5% | 18.0% | 1.6% |
| DI Beneficiary by 2011 | 67.7% | 100.0% | 51.8% | 100.0% | 0.0% |
| Concurrent claim | 50.1% | 39.5% | 55.4% | 45.1% | 60.6% |
| Terminal illness | 0.7% | 1.7% | 0.2% | 0.9% | 0.2% |
| Age | 47.2 | 51.1 | 45.2 | 49.1 | 43.2 |
| | (10.9) | (10.5) | (10.6) | (10.1) | (11.6) |
| Earnings (2008$) | | | | | |
| 3-5 years prior | 22,451 | 28,619 | 19,397 | 25,715 | 15,596 |
| | (27,501) | (33,376) | (23,475) | (29,370) | (21,532) |
| 2 years later | 4,059 | 1,732 | 5,211 | 1,978 | 8,430 |
| | (12,349) | (12,087) | (12,315) | (10,482) | (14,623) |
| 4 years later | 3,688 | 1,661 | 4,651 | 1,494 | 8,173 |
| | (11,783) | (11,320) | (11,875) | (9,303) | (14,686) |
| 6 years later | 3,500 | 1,603 | 4,372 | 1,286 | 7,904 |
| | (11,082) | (8,762) | (11,898) | (7,487) | (15,050) |
| Employed (earning more than $1,000) | | | | | |
| 2 years later | 25.4% | 11.7% | 32.2% | 14.4% | 48.5% |
| 4 years later | 21.3% | 10.3% | 26.5% | 10.2% | 43.8% |
| 6 years later | 19.4% | 9.7% | 23.8% | 8.5% | 40.9% |
| Performing SGA (earning more than real SGA threshold) | | | | | |
| 2 years later | 12.4% | 3.9% | 16.6% | 5.2% | 27.4% |
| 4 years later | 10.8% | 3.6% | 14.3% | 3.5% | 25.8% |
| 6 years later | 10.3% | 3.6% | 13.4% | 3.0% | 24.9% |
| n | 1,056,367 | 349,790 | 706,577 | 715,646 | 340,721 |

Note: Standard deviations in parentheses.

**Table 2. SSDI Processing Times in Months:**
**Cumulative Time from Filing to Observed Decision, by Administrative Level**

| | % Cases | Mean | Std. Dev. | 50th Perc. | 90th Perc. |
|---|---|---|---|---|---|
| Initial | 100.0 | 3.8 | 2.1 | 3.4 | 6.2 |
| Time at DDS office | 100.0 | 2.9 | 1.7 | 2.7 | 5.1 |
| Reconsideration | 27.8 | 9.0 | 4.0 | 8.1 | 14.1 |
| ALJ | 32.4 | 33.8 | 18.9 | 29.0 | 64.0 |
| Higher Appeals* | 0.3 | 54.0 | 13.4 | 54.4 | 71.4 |
| Reapplication | 10.7 | 31.9 | 17.1 | 27.6 | 58.4 |
| | | | | | |
| Final Decision | 100.0 | 14.2 | 17.7 | 5.5 | 37.3 |

Note: * indicates we only observe time to decision at these stages if the final decision is allowance.

**Table 3. Mean Processing Time in Months by Final Disposition**

| | Final Disposition: Allowed | | Final Disposition: Denied | |
|---|---|---|---|---|
| | Initially Allowed | Allowed on Appeal or Reapplication | Initially Denied, Denied on Appeal | Initially Denied, No Appeal |
| No. observations | 349,790 | 365,856 | 119,162 | 221,559 |
| Percentage | 33.1% | 34.6% | 11.3% | 21.0% |
| Time at DDS | 2.8 | 3.1 | 2.9 | 2.9 |
| | (1.8) | (1.6) | (1.6) | (1.6) |
| Total Processing Time | 3.7 | 26.6 | 26.2[c] | 3.7 |
| | (2.2) | (18.8) | (22.7) | (2.1) |
| Total Processing Time, Pooled | 15.4 | | 11.6[c] | |
| | (17.7) | | (17.3) | |

Notes: Standard deviations in parentheses. [c] Denotes censored due to unobserved higher

**Table 4. First Stage Regressions of Time to Decision on Examiner's Average Processing Time (EXTIME)**

| | All Applicants | | Initially Allowed | Initially Denied | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| | Initial Time | Final Time | Final Time | Initial Time | Final Time |
| EXTIME | 0.958*** | 1.477*** | 0.923*** | 0.973*** | 1.534*** |
| | (0.0057) | (0.0504) | (0.0082) | (0.0060) | (0.0446) |
| $R^2$ | 0.134 | 0.005 | 0.114 | 0.146 | 0.004 |
| Plus assignment variables | 0.907*** | 0.962*** | 0.858*** | 0.924*** | 1.015*** |
| | (0.0066) | (0.0335) | (0.0093) | (0.0067) | (0.0404) |
| $R^2$ | 0.163 | 0.044 | 0.169 | 0.168 | 0.023 |
| Plus individual characteristics | 0.900*** | 0.955*** | 0.848*** | 0.919*** | 1.003*** |
| | (0.0065) | (0.0307) | (0.0092) | (0.0067) | (0.0390) |
| $R^2$ | 0.175 | 0.104 | 0.185 | 0.179 | 0.06 |
| n | 1,056,367 | 1,056,367 | 349,790 | 706,577 | 706,577 |

**Table 5. Effect of Examiner Average Processing Time (EXTIME) on Initial Determination, Appeal Rate and Benefit Receipt**

| Outcome | N | Mean Dep. Var. | Coeff. on EXTIME | Std. Error | $R^2$ |
|---|---|---|---|---|---|
| Initial Denial | 1,056,367 | 0.669 | 0.00143 | -0.00131 | 0.208 |
| Continue Claim (Appeal or Reapply) \| Initial Denial | 706,577 | 0.641 | 0.00274*** | -0.00099 | 0.067 |
| Appeal \| Initial Denial | 706,577 | 0.612 | 0.00533*** | -0.00100 | 0.072 |
| Reapply \| Initial Denial | 706,577 | 0.157 | -0.00722*** | -0.00070 | 0.025 |
| Receive Benefit | 1,056,367 | 0.677 | 0.00256*** | -0.00086 | 0.125 |

**Table 6. First Stage Regressions of SSDI Receipt and Time to Decision on Examiner's Allowance Propensity (EXALLOW) and Average Processing Time (EXTIME)**

| | Dependent Variable | |
|---|---|---|
| | (1) | (2) |
| | SSDI Receipt | Final time |
| EXTIME | 0.00334*** | 0.924*** |
| | (0.00073) | (0.02700) |
| EXALLOW | 0.172*** | -6.736*** |
| | (0.00711) | (0.25900) |
| $R^2$ | 0.126 | 0.105 |
| n | 1,056,367 | 1,056,367 |

**Table 7. OLS and 2SLS Estimates: Effect of Final Time to Decision on Labor Supply Outcomes, Initially Allowed Applicants Only**

| | (1)<br>2 Years Later<br>(2007) | (2)<br>3 Years Later<br>(2008) | (3)<br>4 Years Later<br>(2009) | (4)<br>5 Years Later<br>(2010) | (5)<br>6 Years Later<br>(2011) |
|---|---|---|---|---|---|
| | | | A. Dependent Variable: Earn >= $1,000/Year | | |
| Final Time (OLS) | -0.00213*** | -0.00221*** | -0.00172*** | -0.00166*** | -0.00195*** |
| | (0.000251) | (0.000250) | (0.000249) | (0.000246) | (0.000249) |
| $R^2$ | 0.051 | 0.055 | 0.05 | 0.049 | 0.053 |
| Final Time (2SLS) | -0.00352*** | -0.00391*** | -0.00249** | -0.00272*** | -0.00350*** |
| | (0.001100) | (0.001060) | (0.001020) | (0.001030) | (0.001040) |
| $R^2$ | 0.051 | 0.054 | 0.05 | 0.049 | 0.053 |
| | | | B. Dependent Variable: Earn >= SGA | | |
| Final Time (OLS) | -0.00141*** | -0.00127*** | -0.00102*** | -0.00104*** | -0.00107*** |
| | (0.000149) | (0.000154) | (0.000151) | (0.000149) | (0.000156) |
| R^2 | 0.036 | 0.037 | 0.037 | 0.038 | 0.041 |
| Final Time (2SLS) | -0.00115* | -0.00104 | -0.00105* | -0.00069 | -0.00127* |
| | (0.000685) | (0.000656) | (0.000634) | (0.000657) | (0.000700) |
| $R^2$ | 0.036 | 0.037 | 0.037 | 0.038 | 0.041 |
| | | | C. Dependent Variable: Annual Earnings | | |
| Final Time (OLS) | -46.90*** | -52.56*** | -45.55*** | -44.94*** | -47.71*** |
| | (8.19) | (6.65) | (7.74) | (7.04) | (7.06) |
| $R^2$ | 0.039 | 0.042 | 0.029 | 0.041 | 0.046 |
| Final Time (2SLS) | -68.12 | -76.47** | -18.12 | -51.68 | -71.84** |
| | (44.09) | (34.89) | (46.88) | (36.13) | (34.87) |
| $R^2$ | 0.039 | 0.042 | 0.029 | 0.041 | 0.046 |
| n | 349,790 | 337,881 | 327,273 | 317,449 | 307,869 |

**Table 8. Effect of Time to Decision on Employment Before vs. After Waiting Period (WP) Has Elapsed, Control Function Estimates**

| | (1) | (2) | (3) |
|---|---|---|---|
| | 2 Years Later (2007) | 4 Years Later (2009) | 6 Years Later (2011) |
| Time Before WP | 0.0000505 | 0.000293 | -0.00166 |
| | (0.001200) | (0.001010) | (0.001120) |
| Time After WP | -0.00432*** | -0.00313*** | -0.00395*** |
| | (0.001140) | (0.000948) | (0.001020) |
| Elapsed time onset to filing | -0.000853*** | -0.000808*** | -0.000748*** |
| | (0.00006) | (0.00005) | (0.00006) |
| Residual from first stage | 0.00128 | 0.000658 | 0.00152 |
| | (0.00117) | (0.00102) | (0.00106) |
| $R^2$ | 0.053 | 0.052 | 0.054 |
| n | 349,790 | 327,273 | 307,869 |

Notes: See text for details of estimation. Standard errors calculated by bootstrap clustered on examiner (S=1,000).

**Table 9. Joint Estimation of Effect of SSDI Receipt and Time to Decision on Employment and Earnings, 2SLS Estimates**

| | (1) 2 Years Later (2007) | (2) 3 Years Later (2008) | (3) 4 Years Later (2009) | (4) 5 Years Later (2010) | (5) 6 Years Later (2011) |
|---|---|---|---|---|---|
| | A. Dependent Variable: Earn >= $1,000/Year | | | | |
| Final time | -0.00355*** | -0.00357*** | -0.00241*** | -0.00204*** | -0.00245*** |
| | (0.00068) | (0.00066) | (0.00063) | (0.00060) | (0.00059) |
| SSDI receipt | -0.479*** | -0.434*** | -0.317*** | -0.289*** | -0.291*** |
| | (0.04070) | (0.03980) | (0.03810) | (0.03650) | (0.03570) |
| $R^2$ | 0.126 | 0.167 | 0.191 | 0.198 | 0.203 |
| | B. Dependent Variable: Earn >= SGA | | | | |
| Final time | -0.00115** | -0.00145*** | -0.00111** | -0.00101** | -0.00129*** |
| | (0.00050) | (0.00052) | (0.00048) | (0.00047) | (0.00047) |
| SSDI receipt | -0.290*** | -0.266*** | -0.194*** | -0.186*** | -0.185*** |
| | (0.03100) | (0.03120) | (0.02890) | (0.02810) | (0.02840) |
| $R^2$ | 0.123 | 0.15 | 0.151 | 0.155 | 0.158 |
| | C. Dependent Variable: Annual Earnings | | | | |
| Final time | -52.05** | -50.04** | -36.05* | -43.03** | -52.55*** |
| | (21.11) | (19.46) | (21.18) | (18.53) | (18.64) |
| SSDI receipt | -8,121*** | -6,852*** | -4,907*** | -4,477*** | -5,107*** |
| | (1193.00) | (1099.00) | (1127.00) | (1045.00) | (1066.00) |
| $R^2$ | 0.12 | 0.139 | 0.119 | 0.132 | 0.137 |
| n | 1,056,367 | 1,035,835 | 1,016,380 | 997,368 | 978,122 |

**Table 10. Joint Estimation of Effect of SSDI Receipt and Time to Decision on Probability of Earnings Exceeding $1,000/yr, Claimants with Mental or Musculoskeletal Disorder as Primary Impairment**

| | (1)<br>2 Years Later<br>(2007) | (2)<br>3 Years Later<br>(2008) | (3)<br>4 Years Later<br>(2009) | (4)<br>5 Years Later<br>(2010) | (5)<br>6 Years Later<br>(2011) |
|---|---|---|---|---|---|
| | | | A. Primary Impairment Mental Disorder | | |
| Final time | -0.00398** | -0.00343* | -0.0015 | -0.00348** | -0.00340** |
| | (0.00182) | (0.00175) | (0.00161) | (0.00157) | (0.00157) |
| SSDI receipt | -0.500*** | -0.486*** | -0.345*** | -0.446*** | -0.399*** |
| | (0.088) | (0.085) | (0.080) | (0.080) | (0.078) |
| $R^2$ | 0.103 | 0.131 | 0.163 | 0.13 | 0.151 |
| n | 219,341 | 217,086 | 214,736 | 212,174 | 209,557 |
| | | | B. Primary Impairment Musculoskeletal Disorder | | |
| Final time | -0.00410*** | -0.00366*** | -0.00267*** | -0.00237** | -0.00277*** |
| | (0.00102) | (0.00101) | (0.00096) | (0.00093) | (0.00092) |
| SSDI receipt | -0.406*** | -0.366*** | -0.247*** | -0.179*** | -0.202*** |
| | (0.06560) | (0.06380) | (0.06150) | (0.05920) | (0.05860) |
| $R^2$ | 0.167 | 0.210 | 0.213 | 0.206 | 0.222 |
| n | 400,061 | 396,252 | 392,299 | 388,096 | 383,530 |

**Table 11. The Effect of SSDI Award on Probability of Positive Annual Earnings (>$1K) in Years Following Application, Impact of Accounting for Processing Time**

| | OLS (1) | 2SLS: Excluding Processing Time (2) | 2SLS: Including Processing Time (3) | N |
|---|---|---|---|---|
| 2 Years Later (2007) | -0.310*** | -0.332*** | -0.479*** | 1,056,367 |
| | (0.0011) | (0.0350) | (0.0407) | |
| 4 Years Later (2009) | -0.316*** | -0.218*** | -0.317*** | 1,016,380 |
| | (0.00108) | (0.0348) | (0.0381) | |
| 6 Years Later (2011) | -0.303*** | -0.191*** | -0.291*** | 978,122 |
| | (0.00104) | (0.0331) | (0.0357) | |